A REVIEW OF PLANNING APPROACH FOR REHABILITATION OF WATER DEVELOPMENT PROJECTS IN BANGLADESH

BY

A Q MOHAMMAD ALI

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF ENGINEERING (WATER RESOURCES)

DEPARTMENT OF WATER RESOURCES ENGINEERING
BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY
DHAKA, BANGLADESH

JULY, 1993

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF WATER RESOURCES ENGINEERING

We hereby recommend that the thesis prepared by

A. Q. MOHAMMAD ALI

entitled "A REVIEW OF PLANNING APPROACH FOR REHABILITATION OF WATER DEVELOPMENT PROJECTS IN BANGLADESH" be accepted as fulfilling this part of the requirements for the degree of Master of Engineering (Water Resources).

Chairman of the the Committee — Prof. Ainun Nishat

Member — Prof. Abdul Hannan

Member — Prof. M. Fazlul Bari

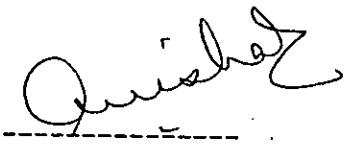
Head of the Department — Prof. M. Fazlul Bari

25-7-93

CERTIFICATE

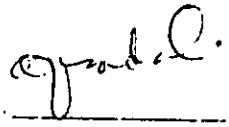
This is to certify that this project report has been done by me and neither this report nor any part there of has been submitted elsewhere for the award of any degree or diploma.

Counter signed



Dr Ainun Nishat
Supervisor

Signature



A Q Mohammad Ali
Candidate

Acknowledgement

The author acknowledges his sincere gratitude and indebtedness to Dr. Ainun Nishat, Professor of Water Resources Engineering Department for his constant supervision, moral support and advice during the course of studies and preparation of reports. It is a great privilege for the author to work with Dr. Nishat whose constant guidance and inspiration made it possible to conclude this work successfully.

The author wishes to expresses his warm gratitude to the other members of the thesis committee, Prof. Abdul Hannan, Professor of Water Resources Engineering Department and Prof. M. Fazlul Bari, Professor and Head of the Department of Water Resources Engineering for their valuable comments, constructive criticism and suggestions regarding the study.

The author expresses gratitude to the officials and consultants associated with the BWDB's Systems Rehabilitation Projects for the help and cooperation at different stages of this study.

Specially the author expresses indebtedness to his wife, Nilufar for her constant cooperation and encouragement in prosecuting the study.

Finally the author wishes to thank Mr. Amal Krishna Debnath and Mrs. Shahida Begum for their help in typing and drafting the report.

ABSTRACT

Over last 30 years about 440 small, medium and large water development projects have been implemented in Bangladesh. According to a recent survey about 200 of them need rehabilitation for not serving the purpose for which these were executed. Towards this Bangladesh Water Development Board (BWDB) has taken up for rehabilitation of about 80 projects in the first phase. Feasibility reports were prepared for 21 projects in 1988. The present study was taken up to review these feasibility reports so as to develop an understanding of the changes in planning approach needed at the rehabilitation phase. This was to be achieved by comparing the approaches adopted at the initial phase with that of rehabilitation phase. The study also reviewed available evaluation reports that have identified deficiencies in operation and maintenance of already completed projects in order to establish the issues that need to be addressed to in a rehabilitation programme. Then an in-depth evaluation was carried out for three selected projects with the help of a strucutured questionnaire, field visits and study of relevant documents. The three projects were selected to represent three different project types namely, early flood protection and drainage improvements, salinity control and drainage improvement, and flood protection, drainage and onfarm irrigation management.

The main findings of this study is that the planners tried to restore the original projects by rehabilitating the damaged structures, repairing the embankments and re-excavating the canals etc. In some cases new structures have been provided to fulfil some of the original objectives that were not made earlier. There has not been significant change in planning appraoch between initial and rehabilitation phases. Many aspects of planning which escaped the attention of the original planners e.g. the impacts on the environment, on project out siders, on open water fisheries, on boat communications etc. have also been over looked in this stage of planning. It has been observed that the socio economic aspects of the project beneficiaries have neither not been considered nor any remedy to their needs have been proposed in the rehabilitation proposals.

The absence of perticipation of the beneficiaries in operation and maintenance of the projects and also in the project planning and execution continues as before. This may lead these projects to another rehabilitation stage in future as same factors leading to rehabilitation prevail. However, the experiments in some projects to improve operation and maintenance by forming Embankment Maintenance Group (EMG) and Structure Maintenance Group (SMG) with the local people is an encouraging step.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY/Acronyms

ADB	Asian Development Bank
BC	Branch Canal
Beel	Shallow water body
BETS	Bangladesh Engineering and Technological Services
BRDB	Bangladesh Rural Development Board
BWDB	Bangladesh Water Development Board
CEP	Coastal Embankment Project
CIDA	Canadian Internal Development Agency
CMP	Currugated Metal Pipe
EMG	Embankment Maintenance Group
FAP	Flood Action Plan
FCD	Flood Control & Drainage
FCDI	Flood Control Drainage & Irrigation
FDR	Flood Damage Restoration
FFW	Food For Works
FSL	Full Supply Level
GOB	Government of Bangladesh
Haor	Saucer like depression
IBRD	International Bank for Reconstruction and Development (World Bank)
IDA	International Development Agency (World Bank)
IO&M	Improved Operation and Maintenance
Khals	Natural channel
Kharif	Monsoon crops
Khalashi	Guard of sluice/Regulator
LLP	Low Lift Pump
LS	Lump Sum
MT	Metric Ton
NGO	Non Government Organization
O&M	Operation and Maintenance
PWD	Public Works Department
RCB	Reinforced Concrete Box
RCC	Reinforced Cement Concrete
RCP	Reinforced Concrete Pipe
SDE	Sub-divisional Engineer
SMG	Structure Maintenance Group
SRP	Systems Rehabilitation Project
SSFCDI	Second Small Scale Flood Control, Drainage and Irrigation Project
UNDP	United Nations Development Programme

CHAPTER-I

INTRODUCTION

1.1 INTRODUCTION

Bangladesh is an agrarian country. The government attaches highest priority to the agriculture sector. Implemention of water development projects for minimising flood hazard and provision of irrigation are main components of the strategy to boost agricultural production. Towards this, Bangladesh Water Development Board (BWDB) which is the main government agency with the mandate for overall water resources assessment and development have so far implemented over 440 water development Projects of different types all over the country (WB, 1985). According to an assessment about 200 completed projects have deteriorated to such a stage that they need rehabilitation (UNDP, 1984). Under BWDB's System Rehabilitation Project (SRP) about 80 projects will be rehabilitated in the future years. Feasibility studies for 21 projects have been completed and these are being rehabilitated currently.

Rehabilitation is defined as the restoration of facilities that have deteriorated over time due to inadequate regular maintenance. Two types of rehabilitation can be done namely:

(a) repair that will restore functions that have been lost due to deterioration
(b) repair that will prevent future losses, should the deterioration continue.

The scope of rehabilitation, where appropriate, also included:

i. completion of facilities originally planned but not carried out;
ii. improvement works that would result in greater returns than those originally planned; and
iii. additions that would extend the sub project to areas out side the original boundaries to provide a new category of benefit.

1.2 NEED FOR REHABILITATION

After completion of these projects due attention is not given to maintenance of the infrastructures, such as embankment, regulators, khals, bridges, culverts etc. Operation and Maintenance (O&M) aspect is neglected. As a result the operating capacity e.g. the services expected from these infrastructure deteriorate and in some cases the capacity may be totally lost. Thus the aim of implementation of the project is jeopardised. (UNDP 1984, World Bank 1990).

The factors leading to such condition may be summarised as follows: (DU 1986, BWDB 1988a,b, FPCO 1992)

- indifference of BWDB to maintenance and operation of the project for years together;
- lack of adequate fund out of government revenue budget;
- non participation of the beneficiary in the planning, implementation and operation of the infrastructures;
- inadequacy of planning concept, which cause hardship instead of benefit to the project people;

- adverse effect of the infrastructure on the environment, which provoked the affected people to destroy it;
- belief of people of BWDB's sole responsibility for Operation & Maintenance.

In 1984 about 200 projects were identified (UNDP 1984) which need rehabilitation and improvement to cater for the changed circumstances and to provide the benefit for which it was originally implemented for.

Thus the aim of rehabilitation was fixed (WB 1990) as:
- restoration of the lost facilities
- completion of facilities originally planned but not carried out
- improvement works that would result in greater returns than those originally planned.
- additions that would extend the sub project to areas out side the original boundaries to provide benefit to new areas.
- to introduce improved O & M after completion of rehabilitation
- to introduce on Farm development in selected scheme to encourage farmers to make better use of infrastructure provided particularly for irrigation.

1.3 OBJECTIVE OF THE PRESENT STUDY

The objective of this study is to compare the planning approaches and criteria adopted during the initial planning of the project with the approaches followed and adopted during rehabilitation planning.

It is expected that this study will establish the deficiencies of planning at rehabilitation stage and whether the following points have been adequately addressed to:
- the changed cropping pattern and intensity, water requirements and land use pattern, the security against possible drought or flood disasters
- the needs for operation and maintenance of the project
- inclusion of the beneficiaries in all stages of the project
- needs of agricultural inputs and credit requirements
- mitigation measures for advers environmental and other impacts e.g. on fisheries, boat traffic etc.

CHAPTER-II

LITERATURE REVIEW

2.1 NEED OF FCDI PROJECTS IN BANGLADESH

Bangladesh is dominantly an agricultural country. 80% of the its population depends on agriculture for their livelihood. It has 8.6 million hectare of net crop land on which some 18 million tons of food grains are grown to feed its vast 110 million population. The average growth rate of population is about 2.4% per year.

Population is growing but the land resource of the country is either fixed or decreasing for settling the increased population. On average about 30% of the country's agricultural land are susceptible to inundation for about six months in the year to varying depth of inundation (0.3m to 5m). During this period crop production is in danger of loss due to sudden and excessive rise of water, cyclonic storm, drought and other natural disaster. More over in the medium high land (0.3m to 1.8m depth of inundation) only the very low yielding broad cast Aus and Aman can be grown and harvest are very risk prone. In the deeply flooded area (inundation more than 1.8m) which is about 15% of total cropped land, no crops are grown during monsoon and the land remain under water for the whole monsoon period. Now the only way to increase crop production to commensurate with the increasing population is to bring more land under irrigation and increase yield per hectare by controlled flood, improved drainage, introduction of high yielding variety and to take due care for pest control.

The government of Bangladesh had set target to bring 3.34 million hectare of land under flood control and improved drainage within third five year plan period so that cropping pattern and intensity can be improved with irrigation during monsoon.

In coastal belt of Bangladesh, polder projects have been developed by constructing embankment for flood and saline water control and in these projects local variety of rice both transplanted and broadcast are produced depending upon the rainfall during monsoon. But while these projects were conceived planners thought of control of salinity and flood but not of modern irrigation. Now the planners are thinking to bring these polder projects under intensive agricultural pursuit specially during monsoon by providing surface irrigation where the water out side is not saline so that maximum production can be achieved out of this land.

Moreover it is possible in the FCDI projects to retain much water in the beels and other water bodies after monsoon recedes and use these water for irrigating wheat and other rabi crops which need minimum water.

So it is imperative for self sufficiency in food to bring more lands under controlled flooding with improved drainage and pursue intensive agriculture by introducing local improved variety and high yielding variety of rice. In addition in the deeply flooded area where only winter crops are possible and where there

is risk of damage due to early flood as in the areas of Sylhet, Mymensingh, Netrokona, Sunamgonj, the partial flood control and drainage improvement project have been proved very useful for ensuring safe harvest. In these area minor irrigation by LLPs are also very potential in the high lands during winter. Drainage improvement specially during post monsoon has also been proved very beneficial in the deeply flooded areas (Haor area) of Bangladesh.

2.2 BACKGROUND OF FCDI PROJECT PLANNING IN BANGLADESH

Prior to 1947 there was very little water resources activities in Bangladesh (then East Pakistan). Directorate of Irrigation responsible for water development activities mainly looked over re-excavation of khals and some beel drainage schemes during those days.

Following the disastrous flood of 1954 and 1955 united nations appointed the Krug Mission in 1957 to review the situation. The Krug mission concluded that water resources development was essential for development of agriculture in Bangladesh and that control of flood should be the first priority. (UNDP 1989, MPO 1991).

A sperate organisation in the name of WAPDA (Water & Power Development Authority) was created in 1959. BWDB is the later adopted name of water wing of the then WAPDA.

In 1964, the then EPWAPDA completed a Master Plan with the help of its General Consultant, IECO (IECO 1964). This plan suggested about 55 large scale Flood Control and Drainage (FCD) and Flood Control, Drainage and Irrigation (FCDI) Projects all over Bangladesh.

The 1964 Master Plan emphasised the construction of embankment on the bank of major rivers of Bangladesh for control of flood and sluices for drainage regulation. Some of the projects have by this time been completed as per this master plan on the different major river basins. Major projects completed are (a) Brahmaputra Right Embankment (b) Pabna Project (c) Karnafully Irrigation Project (d) Chandpur Irrigation Project (e) Manu River Project (f) Meghna-Dhonagoda Project (g) Muhuri Irrigation Project etc. Detail planning and design of these projects have been done by expatriate consultant with local associates. In some project planning, personnel from BWDB participated with the expatriates for detail planning and design works.

In addition many small schemes have been conceived and planned by BWDB professionals working with the directorate of planning and those were normally funded by GOB's own resources

After several subsequent reviews of the completed major projects, World Bank and ADB concluded that performance in implementation, operation, maintenance and agricultural production of such major project is poor. A sector review was conducted in 1972 (MPO 1991, UNDP 1989). A strategy consisting of small, low cost, quick gestation FCD projects and minor irrigation works by low lift pumps (LLP), Shallow Tube Well (STW) and Deep Tube Well (DTW) were adopted with the aim of achieving self sufficiency in food with low investment. Thus since 1972 water

resource development has been a mix of minor irrigation development and low cost FCD schemes along with large, more capital intensive FCDI projects. Till 1988, the contribution of minor irrigation was about 84% and that of traditional gravity irrigation was about 16% to total irrigated land in the country.

Bangladesh again faced disastrous flood in 1987 and 1988. Following this flood a comprehensive study of the water resources for flood control and other development have been taken up in the name of flood action plan (FAP) and some 26 studies have been undertaken under the auspices of World bank with the help of G-7 countries (G-7 communique, July 1989). These studies are in progress and likely to continue for some time more to come up with a definite suggestion and plan of mitigating flood and development of water resources in Bangladesh.

2.3 FINDINGS OF EVALUATION OF SOME FCDI PROJECTS

During the years a substantial number of projects of different size and objectives have been developed by BWDB. But after so many years of project development it has been found on evaluation that many projects have not been able to fulfil its objective. In many cases question of inadequacy of planning and wrong identification of the problems of the area have been detected after completion of the projects. The following were identified as a major inadequacy in the planning and operation of FCDI projects in Bangladesh (BUP 1982, DU 1986, BETS 1989, MPO 1991, HTS 1992).

- Project selection dominated by BWDB's biasness and political influences of local elites.
- No clear social goal is identified and change of need with time are not looked into.
- Projects executed with out regional study (large river basin) as a consequence many small projects are affected by implementation of the others.
- Management need of the project after completion are not given due importance.
- Beneficiaries are not a part of project planning, execution, operation and maintenance.
- Impact of the newly built infrastructures on the existing situation are not given due consideration (environmental impact, impact on project out siders, impact on communications etc.)

Findings of the evaluation of some of the recently completed FCDI projects are given in the following articles.

2.3.1 Evaluation of Chalan Beel Polder-D (BWDB 1988b)

2.3.1.1 The Project in brief

The Project is located in Rajshahi and Naogaon district. The subproject is bounded by the river Atrai in the North, the sib in the west, the Barnai in the south and the Fakirni in the east.

The sub project covers a gross area of 53,055 ha and a net agricultural area of 37,235 ha. The highest land elevation is 16.78 mPWD and the lowest elevation is 7.63 mPWD. There are a number of beels in this project. Some of which remain inundated even late in dry season and thereby these are the natural fish habitat.

The main objective of the Chalan Beel Polder-D subproject is to provide flood protection and drainage improvement and to facilitate irrigation.. The main benefit is accrued from reduction of crop damage by floods. Cropping intensity was expected to rise from 145% to 171% as per P.P. of BWDB.

The main features of the project are 133 km of peripheral embankment, 13 no drainage regulators, 138 km drainage channel improvement, 76 km main road, 25 km village road, 77 irrigation inlet, 20 culvert, 10 bridges and 8 flushing sluices. (Fig. 2-1)

2.3.1.2 Summary of findings

Out of the total 37,235 ha, the area irrigated is 51%. Mechanical irrigation is done by LLPS, DTWS, STWS mainly during winter. The area around the surface water sources specially around the beels and river banks are also irrigated by indigenous method like, dons, sewtis, swing basket etc.

Crops irrigated are mostly Boro, Wheat, T.Aus and T.Aman (Hyv). Crops grown under rainfed condition cover an area of 26,000 ha, about 70% of the total cropped area.

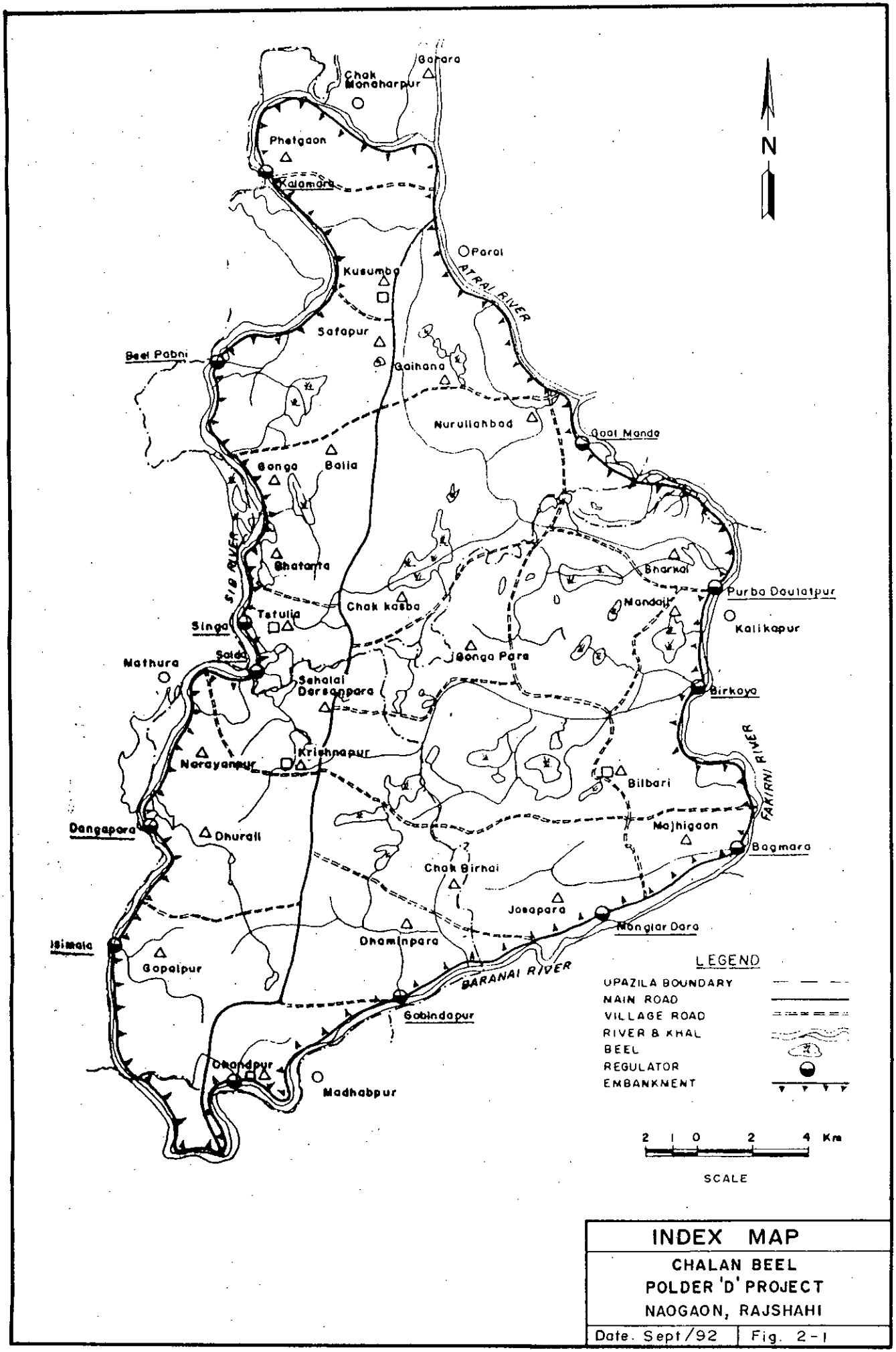
The Kharif crop are the main target of flood damage and in the pre-project condition only the local broadcast Aus and Aman used to be grown. But after the construction of embankment, major shift to transplanted Boro (Hyv) and Aman (Hyv) have been remarkable and this is a very positive impact of this project.

The project was completed in 1988 and again it was damaged during the flood in the same year. Mainly the embankment was damaged. As many as 33 places was breached or opened by the local people.

During the evaluation study in 1989 it was found that the drainage during post monsoon was very slow and as a consequence farmers cut embankment to release water and this has became a yearly phenomenon and it indicates that the drainage planning of this project have not been correctly addressed.

The worst impact of this project have been on open water fisheries. The fisherman community have suffered much. The beels which were earlier famous for different kinds of fish have turned out to be barren. One major cause of fish damage is the use of pesticides during Boro cultivation and the hindrance of the fish fries from entering into the polder during early monsoon period.

The impact of the project on the local water transport system by country boat is immense. As the major portion of this project is deeply flooded and the people are habituated to move by country boats as the villages virtually turn out to be islands during monsoon, the country boat is the only economic way of transport.



INDEX MAP

CHALAN BEEL POLDER 'D' PROJECT

NAOGAON, RAJSHAHI

Date. Sept/92 | Fig. 2-1

The embankment have become a hindrance for movement out side the polder.

The opinion of the people on different issues are give in the table attached. The survey was conducted during the evaluation study in 1989.

Table 2.3.1.3: Respondents Opinion on Specific issues

Description	(% of household)				
	Pure Share Cropper n=15	Small Farmer n=130	Medium Farmer n=37	Large Farmer n=18	All n=200
Water-logging due to drainage congestion	53.3	62.3	56.8	61.1	60.5
Slow recession of flood water	60.0	79.2	62.2	55.6	72.5
Rapid inundation due to breach in embankment	26.7	56.9	45.9	33.3	50.5
High flood in nearby rivers	6.7	53.1	29.7	22.2	42.5
Water transport system disrupted	87.7	96.9	91.9	88.9	94.5
Less production from open water fisheries	100.0	93.1	73.0	72.2	88.0
Increased tension between the project beneficiaries and outsiders	20.0	39.2	24.3	33.3	34.5
Adverse impact on traditional occupations like fishing, net making, boat making, plying country boat etc.	13.3	20.0	2.7	16.7	16.0
Decreased natural fertility of cultivable land due to non-flooding	6.7	33.1	29.7	22.2	29.5
Loss of cultivable land to project structures	-	6.2	10.8	16.7	7.5
Cost of cultivation increased due to changes in cropping pattern	13.3	28.5	24.3	27.8	26.5
Farmer's freedom of use of land reduced	-	9.2	8.1	5.6	8.0

Source : Sample household survey (BETS-DPC), 1989

2.3.2 Evaluation of Satla Bagda Project (BWDB 1988b)

2.3.2.1 The Project in brief

Satla Bagda project is located in South Western Part of Faridpur district and North West of Barishal district. The project is subdivided into three sub-projects known as polder I,II,III, each one surrounded either by a khal or a river. (Fig. 2-2).

The main river touching the project is the Madhumati in the extreme South West, the Ghagor river and Bashdaria khal in the west, Hatra Khal in the South, Otra

and Hindu Nadi in the east while Kotalipara and Gournadi is located in the north.

The project covers a gross area of 29.230 ha spreading over 6 upozilla of which 21,465 ha are arable land. 70% of the total area is moderately flooded area (1.8-3.6m) and 30% are either deeply flooded or perrenial water body and contour of the project varies from 0.0m (PWD) to 1.75m (PWD)

The main physical features of the project is 139 km embankment, 12 drainage regulators of different sizes, 372 inlet structures and 216 km drainage channels. Provision were made for construction of 34 km main road and 32 km village road, with 11 culverts and 5 two-span bridges. A ferry boat was also provided to establish link of the remote areas with the road system. Expansion of irrigation through LLPS and tubewells and associated agricultural input were left to the private initiative of the farmers. DAE was to provide intensive agricultural extension coverage and BRDB was to provide credit support to the farmers.

2.3.2.2 Summary of findings

Out of the total arable area of 21,465 ha, about 8,100 ha are irrigated by LLPs, local indigenous method and through the flushing inlet in the peripherial embankment. Water is flushed into the polder during the high tides through the inlet pipes. Unfortunately about 50% of the pipes are not working properly. In the year 1989 during a survey, 172 nos was found working out of total 372 nos constructed. Present irrigation coverage is about 38% of the total cropped land. potential for further expansion of irrigation is high in this project.

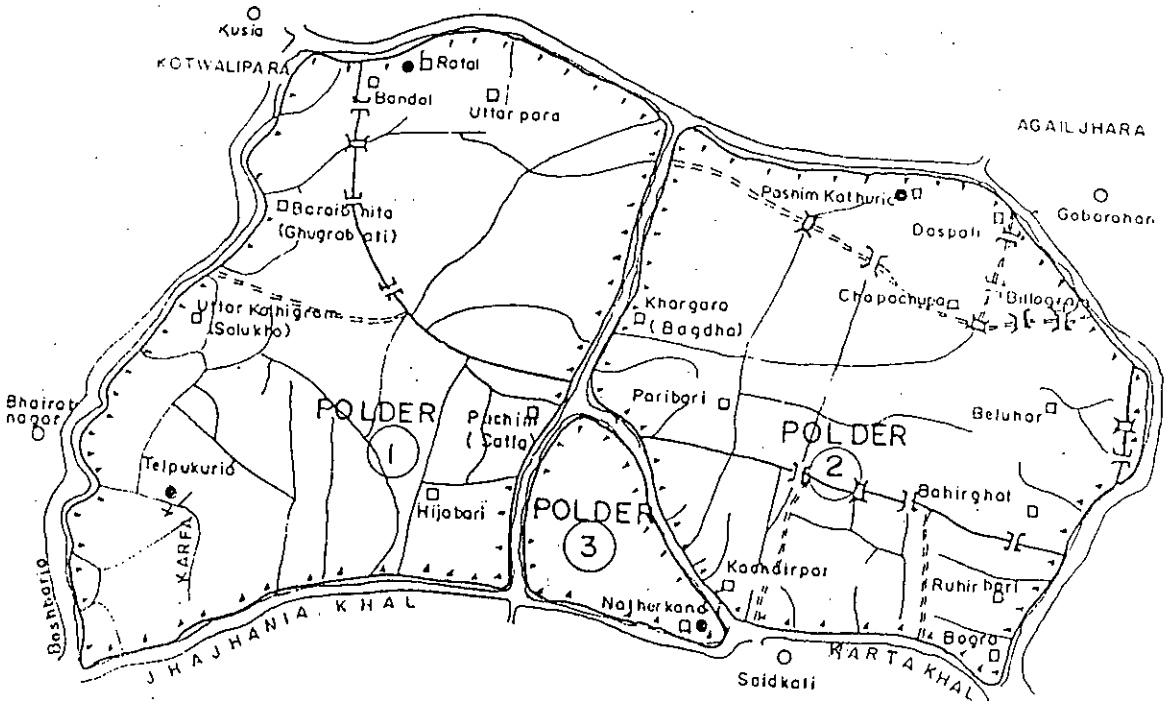
It has been observed that incidence of floods in the sub-project have diminished since the implementation started in 1982. The sub-project suffered heavily from flood and drainage congestion during the flood of 1987 and 1988. Altogether there were 79 public cut and breaches after the 1988 flood. This shows the severity of drainage congestation and problem of local navigation.

The main area of change is the switching over to Hyv crops by expanding more areas under irrigation. New crops are transplanted (Hyv) Aus, Aman and Boro (Hyv). Pre-project cropping intensity of 148% has touched 156% in the year of survey in 1989.

The project development have affected the open water fisheries by primarily affecting the natural breeding in beels and khals and also by discarding the fish route into the project. As per evaluation in 1989, estimated loss of fish production is about 59 tons per year. This has resulted into the migration of the fishermen community into other areas or switching over to other profession.

Navigation by country boat into the project have been adversely affected specially during monsoon season causing inconvenience in carriage of agricultural commodities and passenger traffic. This is one of the cause of frequent public cut of the embankment during monsoon.

The project is expected to reach full development in 1995. Attempts were made to analyse the economic evaluation of the project. The result show that project



LEGEND

MAIN ROAD

EMBANKMENT

VILLAGE ROAD

RIVER & KHAL

0 1 2 3 4 km

SCALE

INDEX MAP

SATLA - BAGDA PROJECT
KOTALIPARA, BARISHAL

Date. Sept/92	Fig. 2-2

would show an EIRR of 18.66 percent with existing production level (BETS, 1989).

The impact of the project on flood out side have definitely increased as well as the drainage congestion in the area.

BETS findings further revealed that there was no participation of the beneficiaries at the stage of project planning and implementation. However, the big farmers were aware of the project and they were in favour of it.

On an enquiry regarding the participitation of the farmers in the operation and maintenance, 70% of the farmers are willing to contribute to the maintenance works and 75% of them are willing to pay for the benefit they have received. With the negative impacts as cited above, the overall opinion of the people are positive about the project and they are willing to harness the best out of it.

The opinion of the people on different issues are given in the table attached. The survey was conducted during the evaluation study in 1989.

Table 2.3.2.3: Respondents Opinion on Specific issues

Description	(% of household)				
	Pure Share Cropper n=13	Small Farmer n=110	Medium Farmer n=23	Large Farmer n=14	All n=160
Water-logging due to drainage congestion	56.9	60.4	59.1	57.2	59.9
Slow recession of flood water	61.4	70.3	60.7	65.8	64.6
Rapid inundation due to breach in embankment	58.5	60.5	63.3	52.5	60.7
High flood in nearby rivers	87.2	85.3	79.7	75.3	83.8
Water transport system disrupted	89.3	91.5	90.7	92.1	90.0
Less production from open water fisheries	71.5	69.7	72.3	71.2	70.3
Increased tension between the project beneficiaries and outsiders	45.7	41.3	35.6	31.8	39.9
Adverse impact on traditional occupations like fishing, net making, boat making, plying country boat etc.	85.9	83.9	80.5	60.7	77.6
Decreased natural fertility of cultivable land due to non-flooding	22.8	30.5	27.8	25.6	30.6
Cost of cultivation increased due to changes in cropping pattern	15.3	25.0	27.3	28.6	27.5
Farmer's freedom of use of land reduced	9.9	8.3	10.3	10.5	11.0

Source : Sample household survey (BETS-DPC), 1989

2.4 EVALUATION BY FLOOD ACTION PLAN OF THE COMPLETED FCDI PROJECTS

Flood Plan Coordination Organization, under the Ministry of Irrigation, Water Development and Flood Control have recently carried out Agricultural study in some 17 completed Flood Control, Drainage and Irrigation Project (FCDI) all over Bangladesh as a component study of Bangladesh Flood Action Plan through Consultant (FPCO 1992). Major findings of this study are summarized in the following chapters. The project studied are as follows : (Fig. 2-3)

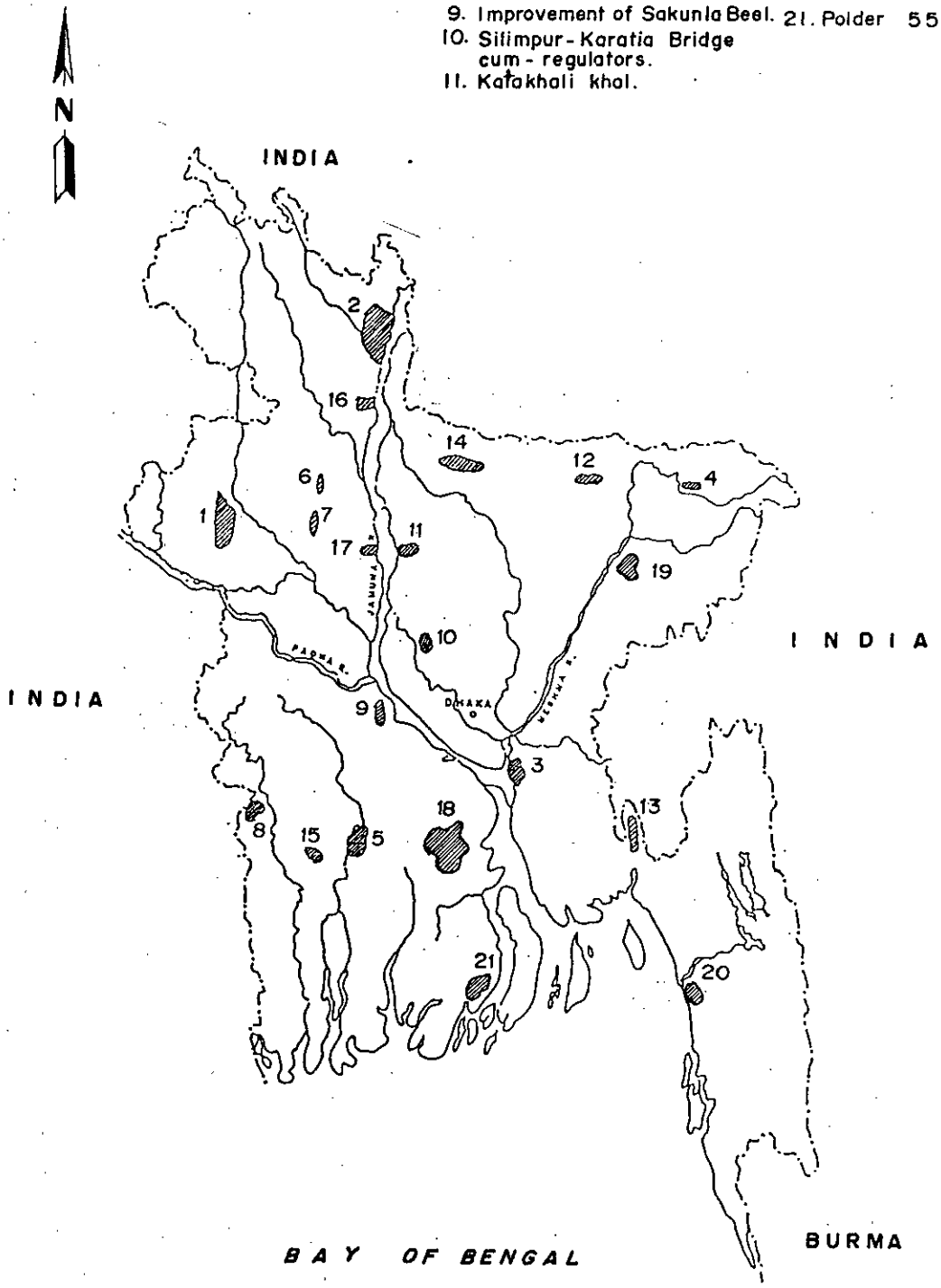
1. Chalan Beel Polder-D
2. Kurigram South
3. Meghna Dhonogoda Irrigation Project
4. Zilkar Haor
5. Kolabashukhali Project
6. Protappur Irrigation Project
7. Nagor River Project
8. Sonamukhi Bon mander Beel Drainage Project
9. Improvement of Sakunia Beel
10. Silimpur Karatia Bridge cum Regulator
11. Khatakhali Khal
12. Hail Haor
13. Kahua Muhuri Embankment
14. Konapara Embankment
15. Polder 17/2
16. BRE Kamarjani
17. BRE Kazipur

2.4.1 Evaluation of Project Planning and Implementation

The project have been planned by BWDB's own planning office and sometimes by the Consultant engaged under some contract. The following observations are common in most of the project evaluated.

- little or no collaboration with other relevant government departments or the beneficiaries have been done
- regional hydrological studies have not been done and insufficient hydrological data have been based for fixation of different parameters.
- embankment alignment have been planned without considering all pros and cons and multiple use of embankments have sometimes not been looked into in many cases.
- designs of embankment and structures were made with inadequate data of hydrological and subsoil condition leading to inadequacy and sometimes failure.
- most inadequacies of design were found in drainage. Almost all the project suffered from drainage congestion after completion and have been subjected to public cut as a temporary relief. Also the boat communication facility have been dislodged.
- most of the project took longer implemention time and as a result cost have increased and in some cases the conditions of hydrology or agriculture have changed due to many other factors and these have not been taken into account by reviewing the planning.
- on many occasions project could not be implemented as designed. Many

1. Chalan Beel Polder 'D'.
2. Kurigram South.
3. Meghna Dhonagoda Irrigation Project.
4. Zilkar Haor.
5. Kolabashukhali Project.
6. Protappur Irrigation Project.
7. Nagor River Project.
8. Sonamukhi Bonmander Beel.
9. Improvement of Sakunla Beel.
10. Silimpur-Karatia Bridge cum-regulators.
11. Kalakhali khal.
12. Halir Haor.
13. Kahua Muhuri Embankment
14. Konapara Embankment.
15. Polder 17/2.
16. BRE Kamarjani Reach.
17. BRE Kazipur Reach
18. Satla Bagda Project.
19. Pagher Haor Project.
20. Polder 64/1A.
21. Polder 55/1.



LOCATION MAP OF THE STUDIED PROJECT
BANGLADESH

Date. Sept./92 | Fig. 2-3

Source : Consultants

component of physical intervention were not completed or dropped. Reasons for this could not be identified definitely.

2.4.2 Evaluation of Agriculture, livestock and fisheries

The FCDI interventions in successful projects have normally increased the production of paddy by changing the cropping pattern from Broadcast Aus/Aman to transplanted variety either local or Hyv. Where the flood control has protected the Boro crop from early flash flood, this has promoted expansion of local Boro and adaptation of Hyv Boro. FCDI Projects have rarely resulted in increased cropping intensities, largely because any land which is cultivable in monsoon season is already used even if with only low yielding varieties.

Where the flood protection is effective, increased level of inputs are applied both to Hyv paddy and other crops.

Normally the impact of FCDI project on livestock is not major. The bulk fodder availability decreases as the grazing opportunity are reduced. Because of more demand of draught power requirement in successful projects, the big farmers are switching over to power tillers for land preparation, which depicts a shortage of drought power in the project.

FCDI project generally cause negative impact on capture fisheries which results from reduction of regularly inundated flood plains and beels and the blockage of past fish migration routes. In addition pesticides used in paddy lands destroy fish species.

Many fishermen have lost their livelihood or been diverted to river fisheries, leading to overfishing in those areas, which are also adversely affected by the change in the fish migration potential. The magnitude of these losses in most cases is substantially greater than estimated earlier.

Flood control has provided opportunities for culture fisheries and the scale of fishpond production has not yet been compared with the decline in capture fisheries.

2.4.3 Evaluation of operation and maintenance practice

Three key issues identified are :

- Resource constraint
- Poor quality of maintenance activities
- Absence of public participation in operation of structures and maintenance work
- O&M manuals are not followed

Because of shortage of domestic resources routine and preventive maintenance are not executed regularly. Over the years projects have been deteriorated to a stage of rehabilitation. These are rehabilitated normally with external borrowed funds and this is normally done often after a major damage. The major portion of the annual budget is spent for excessive staff establishment.

In many projects annual maintenance works are being done through food for works programme especially the maintenance of embankment and khals. But the quality of work is poor for poor supervision and other malpractices.

The regulating structures are operated by BWDB more or less as anticipated, where their physical condition permits it. The regulator operating committee though exist officially but does not function effectively and operation is frequently carried out under the influence of powerful local individuals. In some areas operating practices are the subject of serious dispute.

2.4.4 Evaluation of Economic Impacts

The 17 project evaluated have shown an enormous variations in their estimated economic returns. (Table 2.4.7)

8 nos. have shown low returns of an EIRR below 12 percent while 7 have shown an EIRR of 30 percent or more. Net economic benefit were calculated with agricultural benefits minus fisheries losses.

Two factors were critical to project success as

a) Net economic benefit
b) Implementation time

The projects which showed a net annual economic benefit of over Tk. 2000 per hectare and were completed in four years or less had an EIRR of 30% or more and they were all small schemes (9000 hectares or less in gross area) and relatively simple in conception and design.

The project like Meghna-Dhonogoda is a large one with provision of pump house. Capital cost is excessively high and O&M cost also. The project is economically not viable and economic performance is worsened by a history of delayed completion. Its IRR is only 7% and implementation period is 12 years.

The financial and economic performance have been shown in Table-2.4.7

2.4.5 Evaluation of social impacts

The inception of FCDI projects have generated employment in agriculture and allied sectors and also during construction phase specially to the wage labour households of the project area.

To land owners it is a common dissatisfaction as they lose the land permanently and some land holders become landless by this process. Also the payment procedure is very harassing because of the land records system in the country.

FCDI project have frequently generated social tensions in the impacted areas between the project insiders sand outsiders, between farmers and fishermen, between farmers and boatmen and between farmers at different land elevations. Sometimes this conflict recur annually as the benefits from the project are not spread evenly.

Fishermen and boatmen are usually the greatest losers and the agricultural production benefit goes to the larger land owners. Thus FCDI projects in many cases have enhanced hardship to some poor community, which is not mitigated by any other measures.

The project usually provide increased security from flood hazards and intense agricultural activity in normal year but if the embankment are damaged it brings more damage to the crops and other establishments than without project situation. The flood embankment are generally used as road, throughout the year and it is a safe refuge during flood times. In general the landless people are using the embankment slope as their homestead in almost all the FCDI projects in Bangladesh.

2.4.6 Evaluation of Environmental Impact

The Environmental impact of the Projects were assessed in terms of three Categories of issues: physical, biological and human for the 17 Project under study. Evaluation in both the project areas and external areas were Conducted.

The most common positive environmental effects are:

- Reduced flooding in terms of level, timing, rate of rise, duration and extent of flood
- Improved Soil moisture status at critical period by water retention
- Increased land availability due to reduced extent of wet lands
- Increased cropping severity and flexibility
- Improved opportunities for culture fisheries
- Opportunities for afforestation and other tree planting
- Greater Protection for infrastructure with increased human safety and diminished disruption
- Improved road access and communication by embankment and project road
- Substantial economic benefits to the people in terms of incomes, employment, land values and credit worthiness
- Generally favourable social attitudes to the projects despite many complaints.

The most common negative impacts were:

- Increases in the external areas by increasing the river flows, bank erosion and bed scouring, siltation and flooding level etc.
- Drainage congestation due to inadequate design, operation and maintenance of the drainage structures and channels
- High risk in specific areas of Certain Project of future Catastrophic flooding with associated hazards to infrastructure, life and property
- General decline in fish ecology and capture fisheries
- Decline in soil fertility due to diminished aquatic vegetation and micro-biota
- Loss of land to the embankments and other Project works and often with inadequate compensation
- Disproportionate distribution of project benefit and disbenefits, causing some strains on social cohesion.
- Cultivation, land settlement, vegetation clearance, hunting, fishing all

have increased in the project area as population density has increased in an alarming rate over the last few decades.

The FCDI Project undoubtedly contribute to the ecological decline.

Table 2.4.7: Financial and Economic Performance of Projects (1991 prices)

Project	Net Benefited Area(NBA) (ha)	Capital Cost/ha (NBA) (Tk)	O&M Cost Cost/ha (NBA) (Tk)	O&M Cost/ha (% of capital cost/ha)	Annual Ag.Bens per ha (NBA) (Tk)	Annual Fishery loss/ha (NBA) (Tk)	Ag+Fish Benefits per ha (NBA) (Tk)	Estimated Economic IRR (%)	Implementation period (years)
Kahua Muhuri	2024	11512	235	2.0	12352	208	12143	96	1
Sonamukhi-Banmandar	7400	6284	314	5.0	10514	0	10514	65	3
Hail Haor	6586	3671	191	5.2	2372	0	2372	65	1
Konapara Embankment	3116	2634	132	5.0	12095	1161	10934	62	3
Protappur IP	4000	3419	224	6.5	5686	0	5686	54	4
Zilkar Haor (PIE)	4238	17810	333	1.9	3964	n.a.	3964	40	3
Katakhali Khal	2520	7548	0	0.0	3925	1202	2722	30	3
KBK (PIE)	18623	12041	624	5.2	4360	1020	3340	25	7
Kurigram South (PIE)	50000	13672	776	5.7	5610	80	5530	22	10
Silimpur-Karatia	1012	10829	0	0.0	956	n.a.	956	10	1
Sakunia Beel	4400	4787	28	0.6	1023	439	584	10	4
Chalan Beel Polder-D	37235	9196	129	1.4	2402	1488	914	9	8
MDIP (PIE)	14367	129205	2417	1.9	14130	693	13437	7	12
BRE Kamarjani	8783	6619	340	5.1	1547	922	625	3	10
BRE Kazipur	8788	5461	280	5.1	1500	1075	424	0	10
Nagor River	9312	7962	n.a.	n.a.	-1074	n.a.	-1074	-10	2
Polder 17/2 (all)	2792	15136	440	2.9	6229	8453	-2224	-10	13

Source: FAP 12, FCDI Agricultural Study

Notes: Some figures are very rough estimates and should be treated with caution.

2.5 RECENT CHANGES IN PLANNING CONCEPT

As a result of evaluation of performance of the many of the completed projects, the approach to planning is changing.

The main area where changes are taking place are: (BUP 1988, BWDB 1989b, FPCO 1992)

- participation of the beneficiaries in the project identification, planning and execution.
- effect on project outsiders
- effect on regional water balance and drainage alleviation of the project.

- effect on fisheries and fisherman community
- effect on navigation of the local community
- water rate collection for meeting operation and maintenance cost of the projects
- participation of the local poor people in the operation and maintenance of the projects.

To address the effect of the above issues the following steps are being taken in the newly planned projects: (WB 1987, 1989, 1990, FPCO 1992)

a) For beneficiary participation in planning and execution, Local project committee are being formed with beneficiaries at planning stage and pre-project meeting held with the people of different profession and interest of the locality.

b) Adverse effect of the project intervention on drainage and flood situation on project outsiders are given due attention.

c) Impact on navigation are duly considered

d) Consideration of impact on open water fisheries and livelihood of the fisherman community are getting due importance.

e) Participation of the beneficiaries in the operation and maintenance and resource mobilisation through local committees are being studied through pilot project under SSFCDI

f) In some of the big projects where substantial expenditure is incurred on maintenance, operation and supply of water for irrigation, water rates are being imposed on the beneficiaries for recovery of maintenance cost. (SRP water rate component)

g) The planners are also giving due thought to involve the local poor both men and women in the sustainable maintenance of the infrastructure. These are being experimented by forming EMG (Embankment Maintenance Group) and SMG (Structure Maintenance Group) under BWDB's System Rehabilitation Project.

h) Inclusion of environmental Impact Assessment in planning stage has been made mandatory.

CHAPTER-III

METHODOLOGY

3.1 DEVELOPMENT OF METHODOLOGY FOR THIS STUDY

In course of reviewing the SRP planning, the past evaluations of FCDI Projects have been studied in details. So far about sixty completed FCDI Projects have been evaluated over the past twenty years in Bangladesh. They provide a substantial back ground data on the project impact on agriculture, fishery, forestry, livestock and other environmental aspects.

The author has reviewed the detail planning aspects of SRP Projects in general and three projects in particular, keeping the past findings in mind and after his own interview with the beneficiaries as a member of benchmark study team of local consultant of SRP. Obviously Rapid Rural Appraisal (RRA) technique have been adopted for engineering benchmark study of SRP projects. Of late the findings of the agricultural study of 17 completed projects by FAP-12 consultant have confirmed some of the observations of the writer. The summary of their findings along with evaluation reports of two recently completed projects have been incorporated in the present report as a ready reference. These have helped much in reviewing the planning of the rehabilitation projects.

However, the issues like diversity and complexity of projects and inseperability of impacts are the factors which limit proper evaluation of FCDI projects and the present review cannot be expected to overcome that.

3.2 SELECTION OF PROJECTS FOR CASE STUDY

BWDB has currently taken up the rehabilitation of 16 project in 1st stage with an IDA credit out of a total of 80 to be implemented in next 5 years. The following three projects which are being rehabilitated according to the feasibility prepared by the consultant have been selected for in depth study. The selection of the projects have been guided by the following criteria

a) Representativeness of types as:
   - Flood Control and Drainage
   - Flood Control, Drainage and Irrigation
   - Early flood protection and drainage improvement
   - Salinity control, drainage and supplementary irrigation
b) Location of the project to represent different regions
c) Nature of Rehabilitation work involved.

The selected projects are :
a) Pagner Haor Project in Sunamganj
b) Polder 55/1 Project in Patuakhali
c) Polder 64/1A Project in Chittagong.

Pagner Haor is a partial flood protection project aimed to protect boro rice before harvest in month of April and May and a typical one of deeply flooded area in Bangladesh and is meant for rehabilitation and addition of new facilities.

Polder 55/1 project is a flood cum salinity control and drainage project located in the southern tidal area of Bangladesh and a selected project for supplementary irrigation by flushing during monsoon and on farm development activities.

Polder 64/1A is a salinity protection and drainage improvement project in the south eastern region of Bangladesh and facing bay of Bengal directly. Substantial features are being rehabilitated.

All the above projects were completed in the seventies or earlier and are being rehabilitated in the nineties.

3.3 DATA COLLECTION

The main sources of information are original feasibility reports, evaluations reports, rehabilitation feasibility reports and staff appraisal report of World Bank. The reports are available in the O&M directorate and field offices of BWDB. Interview with the officials of Agriculture extension services of BWDB gave good information on the agricultural activity. BWDB field engineers are the sources of information on the current status of the infrastructure. A list of the documents consulted is given in Table 3.3.1.

In addition field visit have been made to these projects as a part of bench mark study under BWDB Systems Rehabilitation Project.

The cultivators have been interviewed and their idea about the project and their problems and need have been identified through group interviews. The majority of the infrastructures which are currently under rehabilitation have been visited and their present condition and performance have been recorded.

The village people called at random at village tea stall or on roads and their opinion about the different aspect of the project have been recorded. The visiting team consisting of an engineer, a socio-economist and an Agronomist interviewed the villagers during the visit.

The team mainly covered the following
- Condition of the different infrastructures
- Services of the structures rendered in the past
- The causes of deterioration of services of the infrastructures.
- Impact on Agriculture, Fisheries, navigation, livestock etc.
- The suggested remedy to regain the past performance.
- The suggested improvement of the project for getting more benefit out of it.

Further to it, socio-economic data have been collected by village enumerators in selected villages through structured questionnaire (sample in Appendix) to have detail information on the life, property, habits, economic and social conditions of the project people.

Table 3.3.1: Background Reports

Sl. No.	Name of the Report	Year of completion	Type of report
1.	Pagner Haor, Sunamganj	1978 1988	1. Original Project Report 2. SRP Feasibility Report
2.	Polder 55/1, Patuakhali	1977 1988	1. Original Project Report 2. SRP Feasibility Report
3.	Polder 64/1A, Chittagong	1967 1988	1. Original Project Report 2. SRP Feasibility Report
4.	Chalan Beel Polder-D, Natore	1988 1982	1. Evaluation study of drainage and Flood control II project 2. Feasibility Study Report of Chalan Beel Polder-D
5.	Satla Bagda Project, Barishal	1988 1982	1. Evaluation study of drainage and Flood controll II project 2. Feasibility Study Report of Satla Bagda Project
6.	FCDI Agricultural Study. Final Report - 4 volumes.	1992	1. Evaluation report of 17 FCDI projects
7.	BWDB Systems Rehabilitation Project	1990	1. Staff Appraisal Report of World Bank

CHAPTER-IV

DATA ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

For the purpose of the present review an in depth study have been done for three projects under rehabilitation. The projects are coastal embankment polder 55/1 at Golachipa, Patuakhali, Polder 64/1A at Bashkhali, Chittagong and Pagner Haor Boro Protection Project in Sunamganj. The study covers the salient features of the projects, reasons for under performances, SRP inter-ventions, O&M practices and expected achievement of SRP interventions. The physical status and operational Condition of different structures and programs of O&M and rehabilitation have been shown in tabular form for each project.

During analysis a flow diagram showing different steps followed during planning of the projects and the causes which lead them to rehabilitation have been shown and thereafter detail analysis was done for individual project. Different aspects of the rehabilitation work and a comparison of different factors considered for planning at this stage for different project have been shown in the discussion chapter at the end.

4.2 STUDY OF COASTAL EMBANKMENT PROJECT-POLDER 55/1, GOLACHIPA, PATUAKHALI

4.2.1 Situation of the Project

Polder 55/1 is situated in Golachipa upazila of Patuakhali district (Fig. 4-2). It is one of the original Coastal Embankment Projects and was completed in 1977.

The polder is situated on the frontier of the sweet and brackish water zones of Bangladesh. This frontier is shifting depending on the supply of sweet water from the North.

4.2.2 General Design

The objectives of the project are to:

- permit agricultural pursuits on land that was otherwise subject to saline water inundation during high tides
- protect the land and people against the frequent cyclonic storm surges during monsoon
- provide adequate drainage facilities for accumulated rains
- facilitate supplementary irrigation on higher lands by flushing during monsoon.

The gross are of the polder is 10,800 ha with a net cultivable area of 7,800 hectare as given in the feasibility report. The natural shape of the polder is like a plate: the periphery is higher than the interior part. Generally, the land is sloping down from North to South.

The protected area is planted to rice and rabi crops.

The project consists of two types of embankment totalling a length of 45 km, a sea dyke (34 km) located by the side of big rivers and an interior dyke (11 km) along the small channels. These have remained basically as they have been constructed originally with some additional works or modifications in the intervening years.

There are 9 drainage sluices of different sizes which allow for drainage of internal runoff. These structures are fitted with flap gates on the river side and fall boards on the country side.

Sixteen flushing sluices of (0.91 x 1.22 m) size were constructed initially to supply irrigation water into the polder by gravity. Each sluice consists of an outlet box in the C/S for distribution of water into the land. The discharge of each sluice is estimated at 700 litre/sec and is supposed to irrigate an area of about 100 hectares. These flushing sluices are also used for surface drainage of high lands during intense rainfall.

Drainage networks within the polder are complex with many interlinked channels.

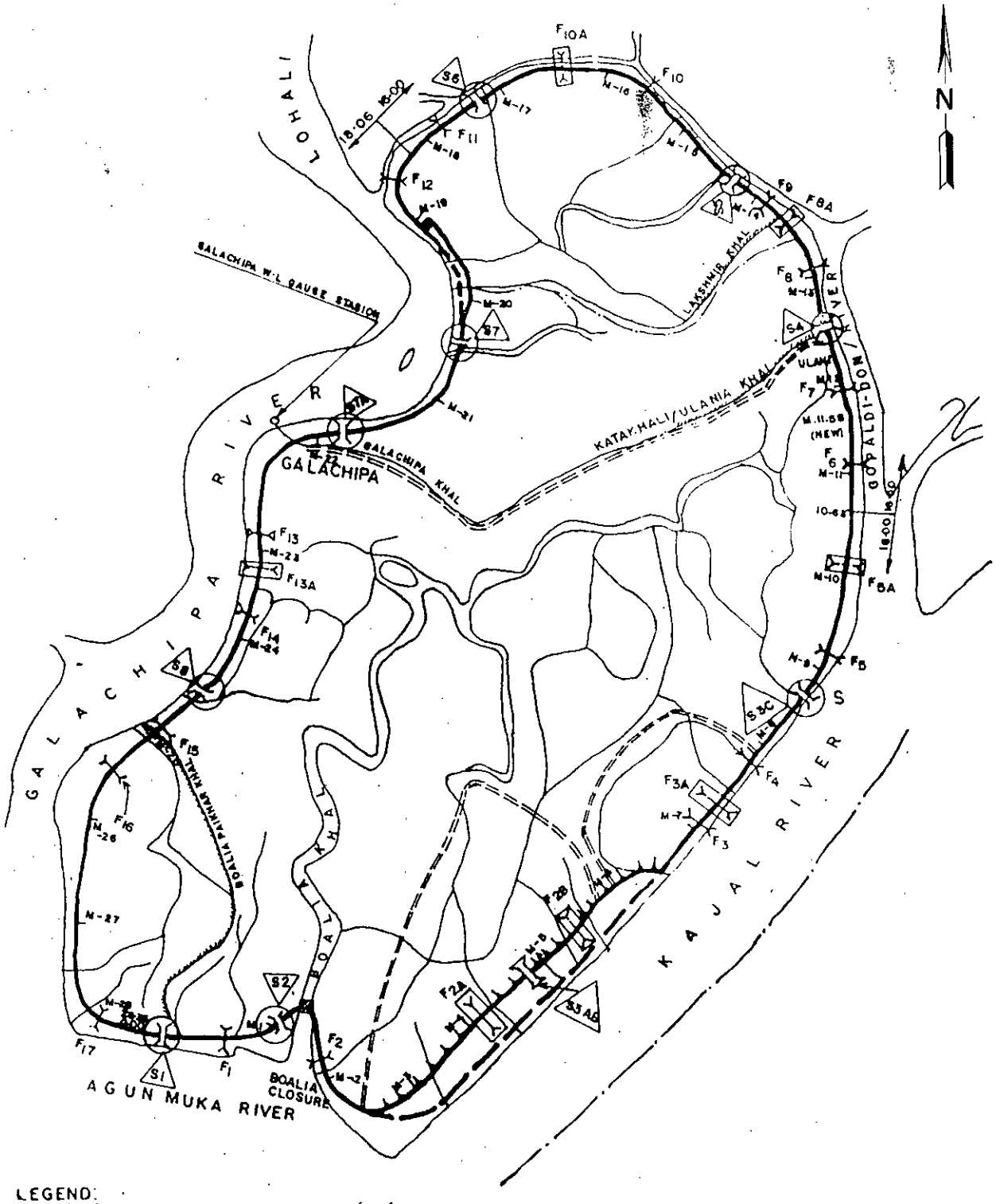
4.2.3 Reasons for under-performance

Intrusion of saline water through the broken flap gates of the nine drainage sluices during the winter is the major cause of under-performance of this project. The estimated crop damage is 20% - 30% of the cultivated area. Saline water also enters through breaches and eroded embankments. A length of about 5 km on the bank of the river Kajal has been eroded away and this reach is being retired under the FDR programme.

The inter-connected drainage channels have accumulated silt which causes drainage congestion in the low lying areas during monsoon. The interior khals have accumulated silt in different locations for a length of about 7.5 km damaging an estimated area of 1440 ha. These khals are proposed to be re-excavated under SRP. As the project is located near the sea shore and in the tidal zone the impact of floods from the upland is more severe during tidal surges or cyclones.

At present the irrigation command area of each flushing sluice is only about 10 ha (as against 100 ha design capacity) because of the absence of a proper distribution system. The flushing sluices, which are supposed to provide supplementary irrigation to about 1600 ha of high lands during monsoon, could therefore cover only one tenth of the area. The utilization of the present facility is thus very poor. The gates and outlet boxes of all these sluices need repair and maintenance in addition to a proper distribution network.

The wooded fall boards in the drainage sluices are not effective for retention of water in the Khal for irrigation during the winter season because water leaks through the wooden logs which are often broken or lost.



LEGEND:

1. RIVER AND KHAL
2. EMBANKMENT :
   (a) Existing (Minor Rehabilitation)
   (b) Eroded
   (c) Under Construction
3. DRAINAGE SLUICE :
   (a) Existing Gate Repair
   (b) Under Construction
4. FLUSHING SLUICE :
   (a) Existing (Minor Rehabilitation)
   (b) Reconstruction
   (c) New
5. RE-EXCAVATION OF DRAINAGE CHANNAL
6. BOALIA CLOSURE
7. ROAD
8. EMBANKMENT CREST ELEVATION (IN FI. P. W. D. DATUM) 18.00 | 18.00

INDEX MAP

COASTAL EMBANKMENT PROJECT
POLDER 55/1
GOLACHIPA, PATUAKHALI

Date : Sept/92 | Fig. 4-2

Waterlogging is a problem in the polder. It is aggravated by the construction of roads (without culverts) under the Upazila Union Council.

4.2.4 Proposed SRP intervention

Polder 55/1 has been earmarked under SRP for rehabilitation, improved O&M and on-farm development.

The rehabilitation intervention in the project includes retirement of 1 km and repair of 45.83 km of embankment including repair of the Boalia closure.

The flap gates of the nine drainage sluices will be replaced and vertical lift gates will be fitted on the country side in place of fall boards.

In addition 4.5 km diversion channel of regulators and 7.5 km drainage channel will be re-excavated under SRP.

Some 27 km of irrigation distribution channels with 288 field turnouts and other associated facilities will be provided for gravity distribution of tidal water which will be available through 16 existing and 7 proposed box flushing sluices and 15 pipe inlets. The existing 16 flushing sluices will also be repaired and remodelled.

The on-farm development activities were in the process of being identified at the time of writing this benchmark study report. The principal structures, their present condition and SRP interventions are shown in Table 4.2.9.

4.2.5 Comments on the proposed SRP interventions

The replacement of flap gates will ensure protection against saline water intrusion and the installation of vertical lift gates on the country side of the drainage sluices will facilitate water retention in the Khals during winter and hence the use of LLP's. But the winter irrigation in this polder especially for Boro rice has suffered during the last few years from crop price problems and from massive pest attacks. So the success of the rehabilitation intervention will depend on meeting the other bottlenecks aside from physical infrastructure.

The programme of on-farm development in this polder is to benefit from irrigation based on the supply of water through the flushing sluices and through the distribution canals which are to be constructed. But the success of intensification of agriculture will depend on the timely completion of the proposed additional facilities and also on the demonstration and motivational work to be undertaken under the on-farm development programme. This again will only succeed if water management is given serious attention by BWDB and if support from other concerned agencies like DAE, BADC, BRDB is ensured.

4.2.6 Present Maintenance Practices

Of all the elements of the project the maintenance of the sea embankment and the sluices have highest priority. The sea dyke is facing the waves of mighty rivers

and is therefore susceptible to bank erosion. Inadequate maintenance, due to shortage of funds and lack of interest, has led to the necessity of rehabilitation of this project.

Maintenance of Embankments

The annual maintenance of the embankments should normally be done under the FFW programme. The embankment on the bank of the Kajal river has been eroded by river erosion for a length of 5 km. A retired embankment had to be constructed and the Boalia closure had to be re-sectioned. These major repairs were mainly done under the FDR but the remaining work is being completed under SRP.

Maintenance of Sluices

All the sluice gates and protective works in the U/S and D/S of the sluices have deteriorated due to inadequate or even lack of maintenance. Most of the flaps have broken at the hinges and leak holes have developed due to rusting. Routine maintenance like greasing, painting or leak repairs is not practised and as a result the steel flap gates deteriorate early.

4.2.7 Present Operation Practices

Operation is to be effected by automatic flap gates and fall boards in the drainage sluices. When the water level on the R/S is higher than on the C/S the flap gates automatically close and when the water level on the C/S becomes higher the flap gates automatically open to drain off the excess water. The fall boards on the C/S are meant for retention of water and also to allow for repair of the structures and the gates. The drainage sluices are to operate round the year. The flushing sluices are to be operated from July to October by opening the gates on the R/S for supplementary irrigation in the peripheral high ridges.

Because all the structures are at present out of order practically no operation can be done. The polder is nearly left to the tides. The Khalashi's, who should operate the system on the instructions of the sluice committees and the BWDB, have virtually no work to do.

4.2.8 Expected Achievements

When the SRP rehabilitation will be completed, the project is expected to be operative to fully satisfy the original objectives.

Land will be protected against saline water intrusion. The protection against flooding during high tides will be brought to the level which was originally planned (the damage at present is estimated at 20-30 % of the cultivated area).

The land will also be protected against flooding during the monsoon due to cyclonic surges (check frequency of flooding).

A strip of land estimated at about 2260 ha along the periphery of the project will be irrigated by the existing flushing sluices (plus those to be constructed newly) and the water distribution system. The present irrigated area by flushing sluices is 130 ha.

There are also prospects of winter irrigation by LLP's in the Northern part of the project, which is relatively high, though on a limited scale. On completion of the rehabilitation works saline water entry into the khals will be stopped improving strongly the environment for irrigation to Boro paddy and other rabi crops also in the lower Southern part of the project. In 1990 some 38 (1, 2 Cusec) LLP schemes were operating in the polder and some 350 ha of land got irrigation through LLPs in the boro and Aman season.

The potential area for irrigation by LLP's is not yet known. According to a report of the DAE Upazila office there is still demand for about 200 LLP's in the winter season if saline water is controlled and insecticides are used for pest control.

On-farm development activities and improved water management in the area covered by irrigation are expected to increase agricultural output.

Drainage congestion will be removed (the estimated damage at present is 1440 ha) after reexcavation of the khals and construction of sluices.

4.2.9 Principal structures, their present condition and SRP intervention

Sl. No.	Item of works	Total Quantity	Size/Section	Present physical status including operational condition	Problem due to structure if any	Program of O&M & Rehabilitation in SRP	Observation on SRP intervention
1	Embankment and closure a) Retiring embankment b) Resectioning c) Minor repair d) Boalia closure resectioning	5 km 45.66 km 0.17 km 0.17 km	Sea dyke R/S slope 7.1 C/S slope 2.1 Interior dyke R/S slope 3.1 C/S slope 2.1 Topwidth 4.27m	Embankment eroded by river Kajal for 5 km. Retired embankment for 4 km completed under FDR Resectioning of eroded section	Saline and flood water enters into the project due to eroded embankment The structure proved useful by controlling water into the projects	Retirement of embankment 1 km Resectioning 45.66 km Minor Repair 0.170 0.17 km	Retirement on the eroded sea dyke mainly done under FDR and FFW programme. The remaining part will be completed under SRP Resectioning needed for protecting the embankment from further deterioration
2	Drainage channel reexcavation including silted diversion channel	12 km	Natural section	Bed silted up by sediment deposition	Causes drainage impediments	4.5 km to be reexcavated under FFW and 7.5 km through contractors under SRP	Recxcavation will alleviate the drainage problem of the affected area
3	a) Drainage sluices repair b) Replacement of flap gate c) Replacement of fall board with vertical lift gate	9 nos. 37 nos. 37 nos.	Vent no.varies from 1 to 15 (1.52x1.83)	In reasonably good condition but flap gates need replacement. Block protection work in D/S and U/S has been damaged for all the structures	Saline water enters through broken flap gates and fall boards do not work for retention purpose	1. Replacement of fall board by vertical gage in C/S 37 nos. 2. Replacement of damaged flap gate 37 nos. 3. Repair of protection work-9 nos.	The drainage sluice can be used for intrustion of sweet water and this can be retained inside the khal by closing the vertical lift gate to be provided inside.

4.2.9 Principal structures, their present condition and SRP intervention (Contd.)

Sl. No.	Item of works	Total Quantity	Size/Section	Present physical status including operational condition	Problem due to structure if any	Program of O&M & Rehabilitation in SRP	Observation on SRP intervention
4	a) Flushing sluices (old)	16 nos.	0.91x1.22	Gate & distribution box damaged	Water cannot be regulated by flap gate	1. Replace R/S flap gate 2. Repair of box	Flushing sluices are potential irrigation aids provided the command area development will be taken up
	b) Flushing sluices	7 nos.	0.91x0.91	Proposed to be constructed new	Does not apply	Does not apply	Additional land can be irrigated by new structures
5	Irrigation pipe inlet	15 nos	25 cm dia pipe	Proposed to be constructed new	Does not apply	15 nos. proposed to be constructed new	Potential for development of irrigation for small catchments
6	Distribution canal and ancillary facilities including farm turn out for flushing sluices	Canal 27 km field turnout 288 nos. Culvert cum check 48 nos. flumes 24 nos.	Various	Newly proposed facilities	Does not apply	Proposed to construct distributin canal 27 km, field turnout 288 nos. Culvert cum check 48 nos. flumes 24 nos.	On farm development for supplementary irrigation has good potential if proper infras-tructure deve-loped and water management is properly attended.

4.3 STUDY OF COASTAL EMBANKMENT PROJECT-POLDER 64/1A, BASHKHALI, CHITTAGONG

4.3.1 Situation of the Project

Polder 64/1A is located in Bashkhali Upazilla under Chittagong district and is one of the original coastal embankment polders (Fig. 4-3). It has been in operation since 1971.

Sea dykes form the western boundary of the project on the Bay of Bengal. The other three sides of the polder are also protected from inundation by interior dykes along the bank of the Shanghu river on the North and Jalkader khal in the South and East.

4.3.2 General Design

The original objectives of the project can be summarized as follows

- protect the land against saline water inundation and thereby allow agricultural activities
- reduce the frequency of flooding due to normal cyclonic storms
- provide adequate drainage facilities for accumulated rain water.

The polder area is some 5700 ha of which 4600 are cultivable.

The project consists of embankments, both inland and sea dyke, drainage sluices, drainage khals, culverts and a bridge.

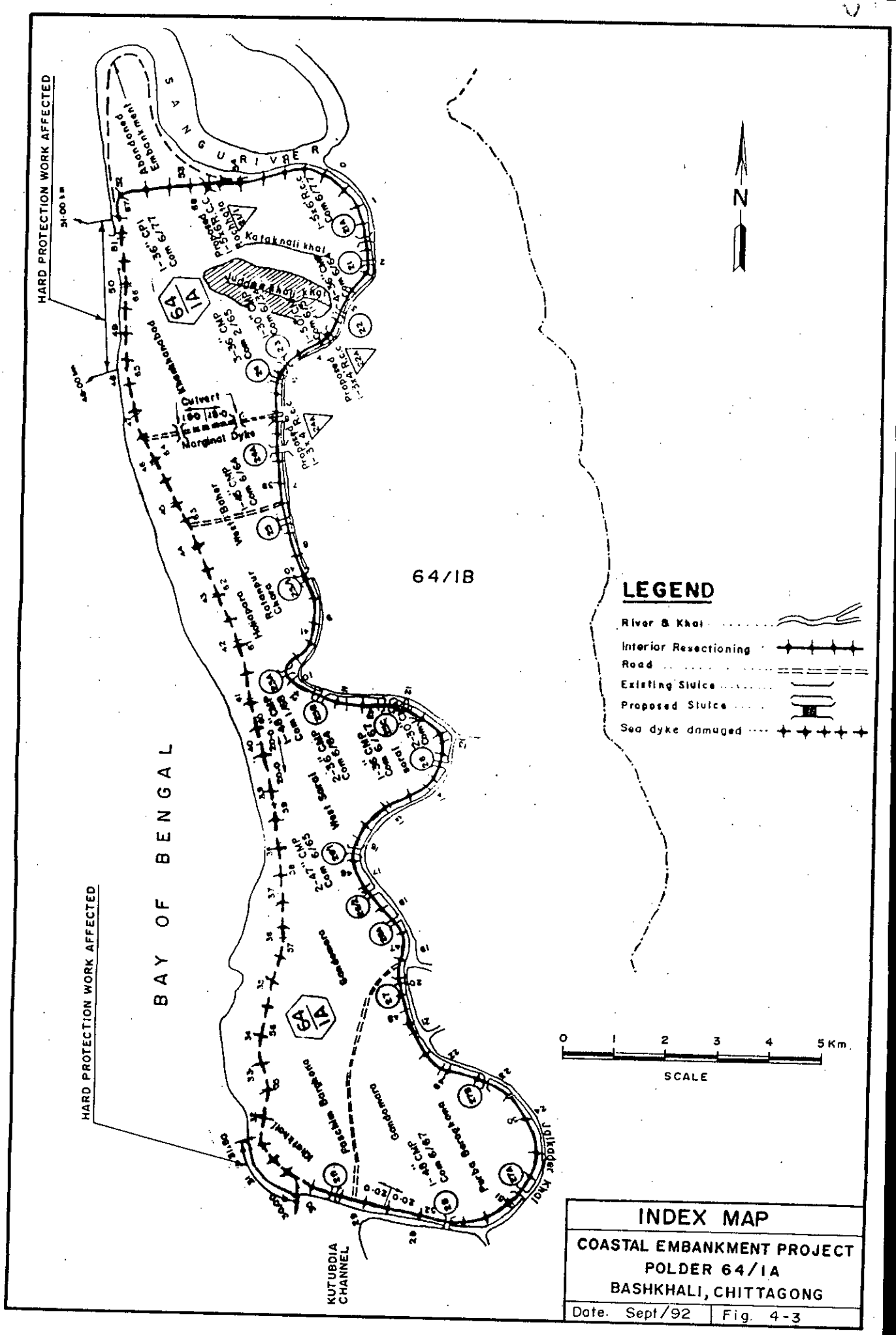
The sea side of the project is protected by some 21 km of sea dyke with a slope of 1:7 on the sea side and 1:2 on the country side. The southern and eastern side are protected by interior dykes for a length of 35 km. The drainage of the project, through internal khals and by overland flow during high rain fall in monsoon, is achieved by some 21 drainage sluices of different sizes. Some 9 sluices originally constructed by CMP have been replaced by RCP or RCB since completion. In addition 8 sluices have been constructed new to relieve the project of drainage congestion.

Rainfed transplanted rice is the main crop in the project area in addition to some rabi crops in winter.

4.3.3 Reasons for Under-performance

The reduction of embankment height by settlement, non-growth of turfs on slopes enhancing erosion and breach in the embankment (through which saline water enters into the project) have been identified as the major causes of under performance of the project. The sea dyke on the western side, being subject to wave wash from the Bay of Bengal, is the reach which is most vulnerable to erosion and breach. Attempts have been made earlier to protect the most critical reaches by hard protection with cement blocks. But these attempts have not been very successful.

Due to the devastating cyclone of April 29, 1991, some 8 km of sea dyke have been heavily damaged in addition to damage of structures and interior dykes.



INDEX MAP

COASTAL EMBANKMENT PROJECT
POLDER 64/1A
BASHKHALI, CHITTAGONG

Date. Sept/92 | Fig. 4-3

The influential people in the polder are in the habit of cutting embankments for preparation of salt beds. These weak sections are vulnerable to breaches during the monsoon tide.

The development of new roads inside the polder has redistributed the drainage zones which necessitates the construction of three new drainage structures. The localised drainage congestion during monsoon where these new sluices have been proposed is another cause of under performance of the project.

The malfunctioning of the ill-maintained flap gates of the existing regulators, through which saline water enters, is also a cause of poor performance.

4.3.4 Proposed SRP Intervention

Due to prolonged deferred maintenance, which the BWDB attributes to a lack of adequate funds, the structures have reached such a state that the project has been earmarked for rehabilitation under SRP.

SRP also intends to introduce improved O & M in Polder 64/1A. The sustainability of the project depends on meeting the yearly maintenance requirements especially for the sea dykes on the west. The project will be rehabilitated under SRP from 1991 onwards. The work will continue till 1994. One year after completion of each part of the rehabilitation programme that part will be brought under improved O & M. Improved O & M will thus gradually be spread over the project. The present experience indicates that a major maintenance effort is required for this project in future years after rehabilitation to sustain the desired level of benefit.

After the cyclone of 29th April, 1991 a recovery programme has to be carried out. It should be mentioned here that SRP's intervention in this polder project is based on the up-dated feasibility report prepared before the cyclone. Additional work caused by the cyclone has not been assessed or incorporated in the SRP rehabilitation programme. Under SRP the following actions will be taken:

- the retirement (5.7 km) and resectioning (6.3 km) of 12 km of sea dyke,
- 1.2 km of hard protection at critical points,
- resectioning of some 27.25 km of interior dyke
- repair of 15 sluices including replacement of corrugated metal pipes by reinforced concrete pipes and flap gates.
- construction of three new drainage sluices
- re-excavation of 2.4 km drainage channel
- construction of a new RCC road bridge.

The principal structures, their present condition and SRP interventions are shown in Table 4.3.9.

4.3.5 Comments on the Proposed SRP Interventions

The protection of the sea side of the project is a major issue of this polder. It is proposed to protect the sea dyke for a length of 1.20 km by hard protection. However piecemeal strengthening of the sea dyke with hard protection works will not be effective as past experience has shown. Hard protection for the

full length of the dyke would be prohibitively expensive. Not surprisingly, during the cyclonic surge of April 29, 1991 the hard protection work was also washed away.

It has been proposed to replace the wooden fall boards at the C/S of the sluices with new ones for post monsoon sweet water retention and also for emergency maintenance. As they have never been effective before rehabilitation they are not likely to give any sustainable result after rehabilitation.

Repair of the four Khalashi sheds would help the operation of the project. But at present the Khalashi do not normally live in the sheds and for some structures no Khalashi are even posted. So the repair of these sheds should be given a second thought before the work is executed.

4.3.6 Present Maintenance Practices

Of all the system elements, the seadyke and its hard protection should be given top priority for maintenance. Secondly the maintenance of the internal dyke, the sluices and the internal khals should be given attention. The present maintenance situation is as follows.

Sea dyke

In spite of past maintenance efforts under the FFW and FDR programmes, severe erosion and breaches at four locations of this embankment due to wave wash from the Bay of Bengal have become a continuing problem. Two important locations have been protected by concrete revetment under FDR programme but, as already pointed out, past experience has shown that partial strengthening of the sea dyke by hard protection has not been very effective. Full length protection would be too expensive.

The embankment has been overtopped during the devastating cyclonic surge of April 29, 1991 causing heavy damage to some 8 km sea dyke as well as to all structures and interior dykes. But even for more normal circumstances an affordable and technically satisfactory solution to the reinforcement and maintenance of the dyke has not yet been found.

Interior dyke

The interior dyke have settled throughout and their slope has eroded due to deferred maintenance. Yearly maintenance is constraint by the wheat available under the FFW programme and is therefore limited to the repair of the most severely damaged sections. On the average, 600 M Ton wheat have been used annually for maintenance of the embankments during the last five years.

Interior Khal

The polder suffers from drainage congestion due to lack of maintenance of silted-up khals in particular the Juggai khal which will be re-excavated under SRP.

Regulators

All the sluices and their protective works have deteriorated due to lack of timely maintenance. A total of 15 sluices need major repairs. Had timely

maintenance been done, the deterioration could have been prevented to some extent. This is applicable to the drainage channels too.

4.3.7 Present operation practices

The operation of the fall boards and automatic flap gates is the main task of operation in this project.

The flap gates are automatically opened when the water level inside the polder is higher. Sometimes debris, logs or water hyacinth hinder operation. These are to be cleared by Khalashi employed by BWDB

As the khalashi sheds are not being maintained, the khalashis avoid living in the sheds. They are often not available on the spot when they are needed.

Wooden fall boards are used at the C/S for water retention or repair purposes. These are operated by khalashi, if available, at the request of farmers and BWDB. However, the fall boards form the main problem in the operation of the sluices. They are not effective for water control and are often broken or lost. Therefore local farmers put earthen bunds in some canals for retention of sweet water after the monsoon.

Some local influential people allow saline water to enter through the flap gates for salt bed preparation. This badly affects the crop production in that area. Some salt producers come to terms with the other farmers by paying them money.

4.3.8 Expected achievements

The retiring and resectioning of the sea dyke with hard protection at some places, the resectioning of the interior embankment and the repair of the gates of the regulators are expected to control the intrusion of saline water into the project protecting the full polder area of 5700 ha.

The repair of the regulators, the re-excavation of the khal and the construction of new regulators are expected to remove the drainage congestion problem during monsoon relieving a total area of 625 ha of drainage congestion.

The construction of the bridge on Jalkader khal at Majarhat and two pipe culverts will facilitate the road communication of the project and thereby stimulate economic activities in the polder.

The feasibility report estimates the extent of under-performance due to drainage congestion on an area of 625 ha at a 20-30% decrease in yield for that are. However, if rehabilitation would not be carried out properly and the deteriorated project features would not be returned to an operational condition, the benefit of flood control and drainage may be lost for the whole project area causing major loss to farming. The economic value of such a loss was calculated at Tk. 921 lakh per year in 1986 prices.

4.3.9 Principal Structures, Their Present Condition and SRP Intervention

Sl. No.	Item of works	Total quantity (existing)	Size/Section	Present physical status including operational condition	Problem due to structure if any	Program of O&M and rehabilitation in SRP	Observations on SRP intervention
1.	Embankment: a) Sea dyke retirement b) Sea dyke resectioning	21 km	Top width-4.27 C/S slope-2:1 R/S slope-7:1	Embankment eroded due to cyclonic & tidal bore waves. Needs retirement and resectioning	If the dyke is not retired and resectioned saline water enters the project	Retirement for a length of 5.70 km. Resectioning of 6.33 km	Retirement & resectioning will provide saline water control through sea dyke. But to be maintained every year performance
	c) Resectioning of interior dyke	35.50 km	Top width-4.27 C/S slope-2:1 R/S slope-3:1	Embankment cut at many places by people and at many places washed away due to recent tidal bore	The embankment has been cut at many places for making salt beds	Re-sectioning for a length of 27.25 km under FFW Programme	Resectioning of interior dyke is required for protecting the project from saline water intrusion and also to prevent it from further deterioration
	d) Hard protective works on sea dyke	1.20 km	Top width-4.27 C/S slope-2:1 R/S slope-5:1	The sea dyke protection work is eroded by recent tidal bore	Embankment is eroded by wave if not protected and important market place is endangered	Protection by concrete blocks for a length of 1.20 km to be done under SRP	Hard protection work done under FDR earlier has been washed away by recent cyclone. So this small length of hard protection is not likely to provide any sustainable solution
2.	Excavation of khals: re-excavation of drainage channel	2.4 km	Bed width variable, side slope-1:1	Juggae khal silted up and causing drainage congestion	Drainage congestion occurs	Re-excavation for a length of 2.40 km under FFW programme	Drainage situation in the catchment of this khal is likely to improve after re-excavation
3.	Pump irrigation: a) Low Lift Pump	2		Privately owned pump	Does not apply	Does not apply	For scarcity of sweet water no potential of irrigation by LLP
	b) Deep Tube Well	6	BADC plans to handover to samity	Operational condition is good	"	"	For high cost of fuel & management problems these are not working properly
4.	Major Drainage Sluices: a) construction of sluice 21/1A	1 no	1x1.5x1.83 m	New structure proposed for relieving drainage congestion	"	"	After construction of the structures the local drainage congestion will be relieved
	b) construction of sluice 22A, 24A	2 no	1x0.9x1.22 m	"	"	"	"

4.3.9 Principal Structures, Their Present Condition and SRP Intervention (Contd.)

Sl. No.	Item of works	Total quantity (existing)	Size/Section	Present physical status including operational condition	Problem due to structure if any	Program of O&M and rehabilitation in SRP	Observations on SRP intervention
	c) Rehabilitation of sluice no 22	1 no	2x0.7 m Dia CMP	CMP broken, brick block and tube well broken	Improper functioning due to damage	1. Replace CPM by RCP 2. Repair protection work	Protection against saline water intrusion & drainage relief will be effected
	d) Resectioning of sluice no 24	1 no	4x0.9 m Dia RCP	1. Flap gate broken 2. Fall board lost 3. protection work broken	Improper functioning due to damage of gate	1. Replace flap gate & fall board 2. Repair brick block and toewall	Protection against saline water intrusion and drainage relief will be effected
	e) Rehabilitation of sluice no 25 c	1 no	2x0.91 m Dia CMP	1. CMP broken 2. Brick block & toewall broken	Structure in bad condition for want of repair	1. Replace CPM by RCP 2. Brick block & toewall repair	"
	f) Rehabilitation of sluice no 25 c	1 no	1x0.91 m Dia CMP	1. CMP broken 2. Brick block & toewall broken	Structure in bad condition for want of repair	1. Replace CPM by RCP 2. Repair of brick block & toewall	"
	g) Rehabilitation of sluice no 26	1 no	2X0.76 m Dia CMP	1. CMP broken 2. Brick block & toewall broken	Improper functioning due to damage of gate	1. Replace CMP 2. Replace flap gate 3. Repair brick block	"
	h) Rehabilitation of sluice no 27	1 no	1x1.22 m Dia RCP	1. Brick block & toewall broken	"	1. Replace flap gate 2. Replace fall board 3. Repair Khalashi shed	"
	i) Rehabilitation of sluice no 28	1 no	1x1.52x1.83 m RCB	1. Flap gate broken 2. Fall board lost 3. Khalashi shed broken	"	1. Replace flap gate 2. Replace fall board 3. Repair Khalashi shed	"
	j) Rehabilitation of sluice no 29	1 no	2x1.52x1.83 m	1. Flap gate not fitted properly 2. D/S protection work eroded	Some local people allow saline water inside for preparation of salt bed	1. Repair protection work at D/S 2. Repair Khalashi shed 3. Repair Khalashi shed	Some people allow saline water for salt preparation through the gate
	k) Rehabilitation of sluice no 25, 25A, 26B, 26/2A, 27/A, 27/B	6 nos	1x1.52x1.83 m	Block protection work damaged in all six sluices	No problem	Replace brick blocks protection work	Rehabilitation will ensure proper service of the structure
	l) Rehabilitation of sluice no 26/A	1 no	2x1.52x1.83 m	"	"	"	"
5	Bridge: replacement of wooden bridge at Mossaraf Ali Majirhat at 6th km	1 no	40 m span RCC bridge	New RCC bridge to be constructed instead of existing wooden bridge which is in dilapidated condition	People cross this bridge with risk and no vehicle can cross it	1 no RCC bridge	The communication of the locality will be improved much
6	Culverts: Pipe culvert	2 nos	-	Project road culvert has broken	Communications suffer due to breakage of the culvert	Replacement of pipe culvert	On replacement communication will be easier

4.4 STUDY OF PAGNER HAOR SUBMERSIBLE EMBANKMENT PROJECT, SUNAMGANJ

4.4.1 Situation of the Project

The Pagner Haor Project is situated in Zamalgonj Upazilla of Sunamganj District. The project is bounded by the Nawa river in the North, the Nawa Baulia river in the North-West and the Piyan river in the East and the South-East. (Fig. 4-4)

4.4.2 General Design

The project covers a gross area of 19,075 ha and a net irrigable area of 17,167 ha.

The aims of the project were to protect the land from flooding up to the end of May to safeguard the harvesting of Boro crops and young seedlings of Aus and Amun.

The project also aims at relieving drainage congestion to allow quick recession of monsoon floods in order to make the lands available for Rabi crops early.

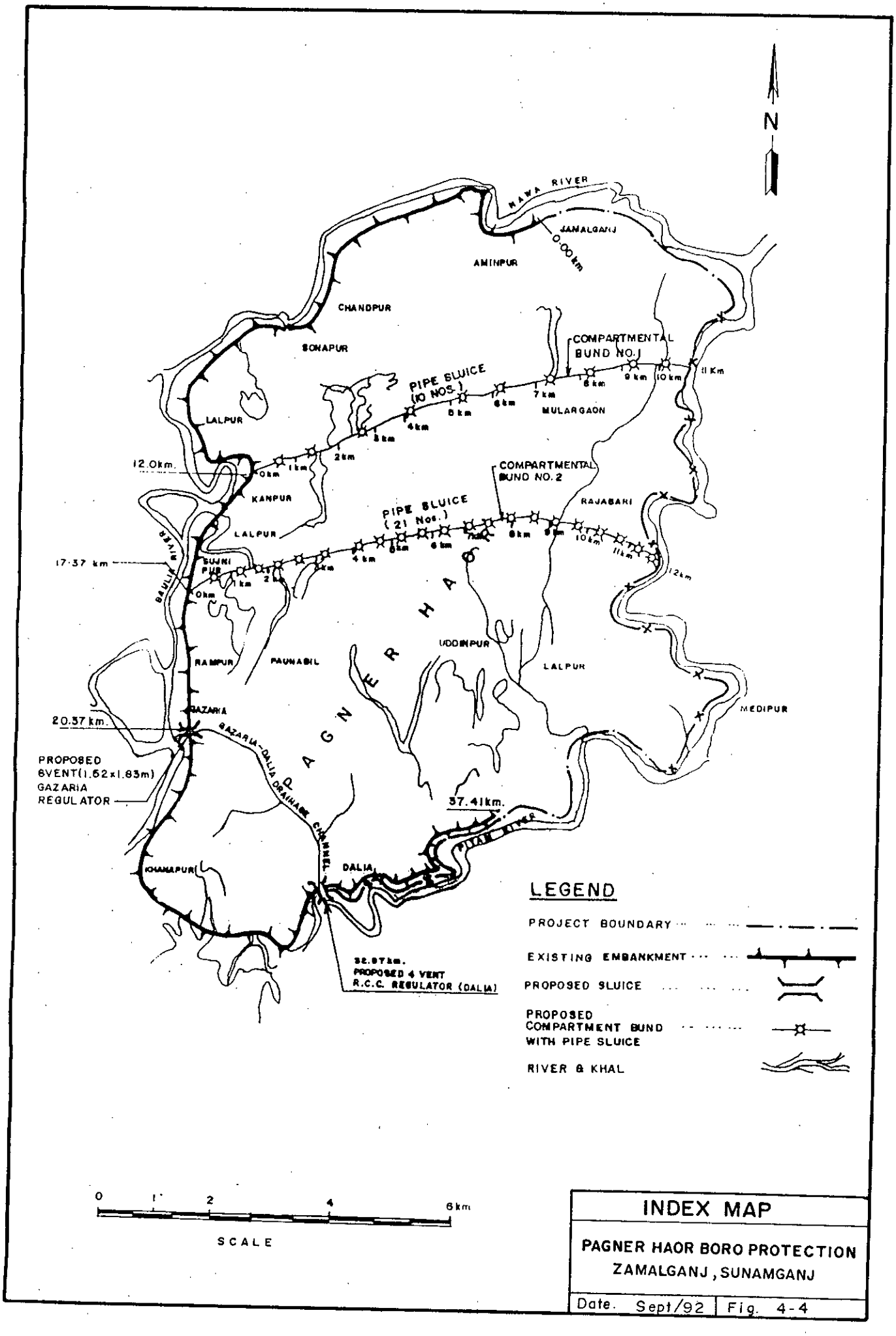
There are about 37 km of submersible dykes constructed under the FFW programme which form the present project. Temporary closures on the existing khals are constructed every year by the local public by their own endeavour.

Pagner khal is the main drainage channel, draining two basins of the project. Several small khals connect the low pockets of the haor (known as Pauna, Uddinpur and Lalpur beel) with Pagner khal which drains into the Nawa Baulia and the Piyan river at Gazaria and Dalia respectively. These drainage khals are badly silted up and cause drainage congestion in the post-monsoon season.

4.4.3 Reasons for Under-Performance

Almost every year the area suffers from early floods which accrue during the pre-monsoon period (April and May) due to intense storms in the hilly regions. The water from the peripheral rivers then enters into the haor area through the creeks and damages the standing Boro crops at the matured stage. To stop the entering of flood water into the haor area during April and May, the local people close the creeks by the end of January putting cross-dams on the creeks at different locations. These cross-dams often break during the early floods due to inadequate sectioning.

The present project thus offers only a temporary protection which is very risky. As a result some 30% of the Boro crops are damaged every year. Therefore cultivators are not interested to go for intensive and improved cultivation practices. During the early flush floods the flood water, breaching the earthen cross-dams, enters into the project through the creeks. Water also enters through the breaches and depressions in the submersible dyke. The flood water deposit silt in the channels which causes drainage congestion.



INDEX MAP

PAGNER HAOR BORO PROTECTION
ZAMALGANJ , SUNAMGANJ

Date. Sept/92 | Fig. 4-4

Retention of water in the higher contour ridges for cultivation is not possible due to the saucer shaped topography of the haor which reduces the coverage of Boro cultivation.

4.4.4 Proposed SRP Intervention

SRP has earmarked the Pagner Haor Protection of Boro Crops Project for rehabilitation and subsequent improved O & M.

The rehabilitation in this project consists of the resectioning of 37.41 km of existing submersible embankment including closing the khals, the re-excavation of 5.78 km of drainage channels, the construction of two drainage cum flushing regulators, and the construction of a compartmental bund including 21 pipe sluices. Although the project is earmarked as a rehabilitation project, it actually comprises so many new elements that it comes down to the construction of a new scheme. The only existing facility is the submersible embankment. Its present status and SRP interventions are shown in Table 4.4.8.

4.4.5 Comments on the Proposed SRP Interventions

It is proposed to construct two big regulators of total 12 vents (1.52 m * 2.44 m) for drainage and flushing purposes. The success of flushing will depend on the proper operation of the gates at the right time as per design. Like in all other projects, the gated drainage structure with reduced opening may increase the drainage evacation time. This can only be confirmed after the regulators have been put into operation.

The small creeks which used to drain the small basins will be closed by embankments. In that case these drainage pockets are to be connected to the existing big khals for their drainage evacuation otherwise local drainage congestion would occur and the project's expected benefit would be lowered.

The two compartmental bunds with 21 gated pipe structures were proposed to proveide water retention for irrigation in the post-monsoon season. But not much irrigation coverage can be expected because of water limitations. The gated pipe culverts will help only to evacuate water retained on the higher ridges. They are not likely to be helpful for irrigation because these lands are used mostly for Rabi crops and the retained water is not sufficient to meet the irrigation requirements. Moreover, the gated pipe culverts may hinder early drainage of the area and hence further reduce the possibilities for irrigation. The bunds will mainly serve the purpose of improved road communication.

The project is expected to help the farmers by allowing a quick discharge of the monsoon drainage load so that lands can be made available for winter crops early. But the conflict between farmers and fishermen about the time the beel should be drained after the monsoon is likely to continue. Indeed, the time for fish catching and for transplanting of Boro crops does not coincide. This is a common problem in all haors in the area. Only an effective sluice committee consisting of BWDB, farmers and fishermen can ensure the operation of the regulators balancing the interests of all the beneficiaries concerned.

4.4.8 Principal Structures, Their Present Condition and SRP Rehabilitation Interventions

Sl. No.	Item of works	Total quantity	Size/Section	Present physical status including operational condition	Problem due to structure if any	Program of O&M and rehabilitation in SRP	Observations on SRP intervention
1.	Embankment: re-selectioning and breach closure at six places	37.4 km	Crest width 8' slope 1:2 C/S 1:3 R/S	Partial damage to submersible dyke 0.9 m to 1.2 m ht with no regulator	Due to breach of the khal closures and the embankment early floods enter the project and damage the crops	37.4 km resectioning; closures of khals	Resectioning of embankment and closing the khals properly will protect Boro crops and prevent erosion by early flood
2.	Excavation of khals: re-excavation	5.78 km	Various	Canal silted up	Drainage congestion occurs	5.7 km to be re-excavated under FFW programme	Re-excavation of khals will ensure quick recession of flood water and stop drainage congestion
3.	a. RCB flushing cum drainage regulator at Gazaria b. RCB flushing dum drainage regulator at Dalia	1 no. 8-vent 1 no. 4-vent	1.52 m x 2.44 m 1.52 m x 2.44 m	To be constructed new To be constructed new	Not applicable Not applicable	New construction New construction	Expected to provide drainage facility and water retention between compartmental bunds
4.	Pipe structures on the compartmental bund	21 nos	0.90 m R.C.C. pipe	To be constructed	Not applicable	New construction	Retaining water for Boro cultivation during dry season may not be feasible; bunds may be used as a road
5.	Compartmental bund	2 nos. total 23 km long	2.44 m top width 1:2 side slope on each side	To be constructed	Not applicable	New construction	

4.4.6 Present Practice of O & M

The present practice of maintenance is restricted to resectioning the heavily eroded reaches of the embankment and to repairing the breaches in the closures on the khals. This is done every year after the monsoon under the FFW programme (to the extent that wheat is available) and by voluntary labour of the farmers. The embankment and the closures are not adequately sectioned to stop the inflow of flash floods. On the average 5 km of embankment and closures used to be resectioned and repaired every year during the last five years.

But proper strengthening of the closures with compaction and other measures required could not be done under the FFW programme. The silted khals in the haor could not be re-excavated either for want of resources.

After rehabilitation, and under the condition of proper maintenance, an operations plan has to be worked out which does justice to the various interest (conflicting) of farmers and fishermen. The improved facilities for water management (regulators, compartment bunds, etc.) should be used to reach an optimal operations plan.

4.4.7 Expected Achievements

The rehabilitation will provide protection against flush floods in the months of April and May and hence will save the matured Boro crops.

On re-excavation and new excavation of the drainage khals the drainage situation will be improved so that the Boro rice can be transplanted earlier and also the production of Rabi crops can be increased.

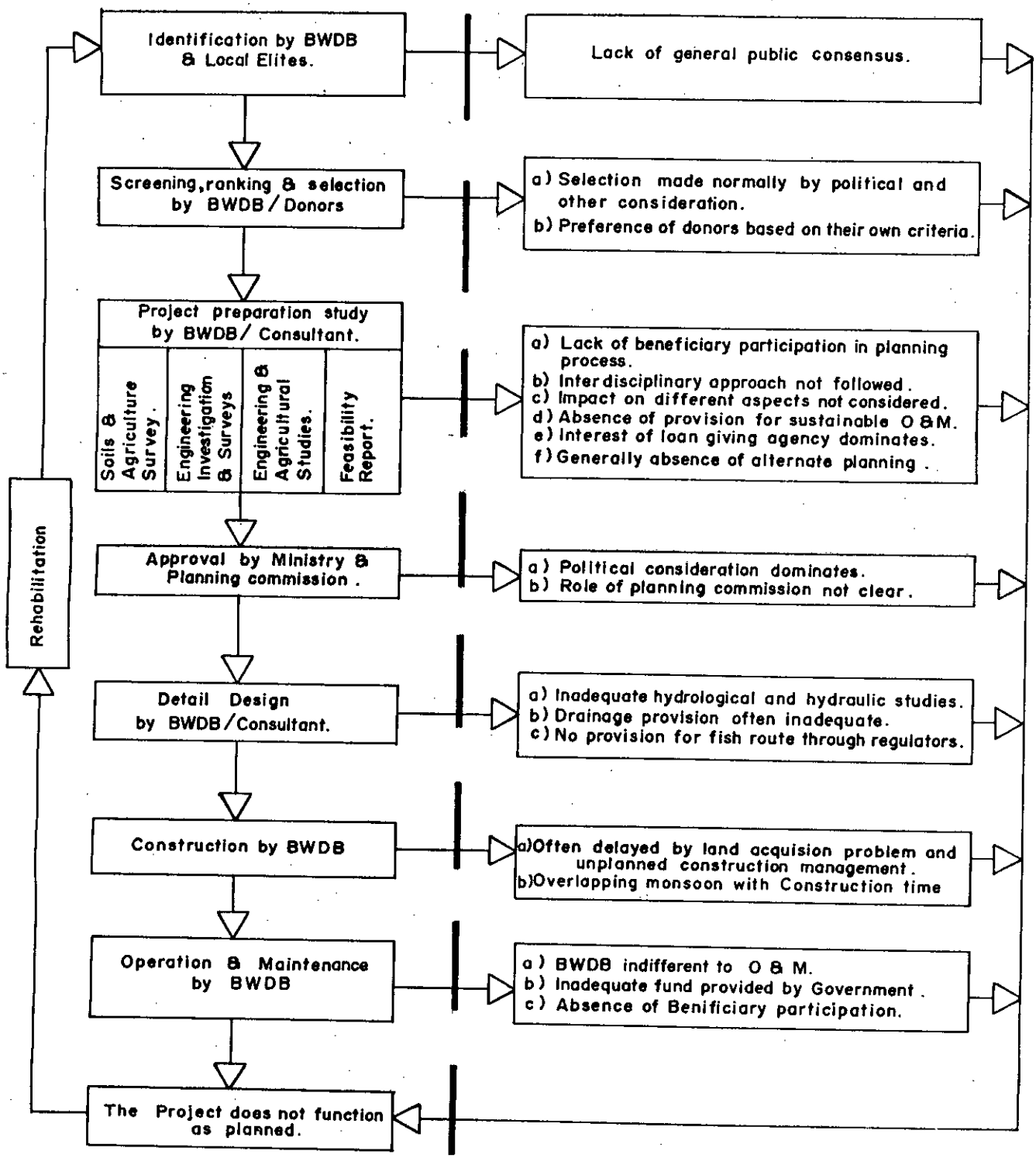
The completion of two drainage cum flushing regulators at Gazaria and Dalia, will ensure early flood protection, minimise the damage of the embankment and ensure water retention for irrigation to Boro crops.

The compartmental bunds are expected to provide facilities for water retention and improved communication in the project area.

4.5 ANALYSIS

It is known that about 200 FCD and FCDI Projects implemented by BWDB have reached to a stage where rehabilitation is required for getting the lost benefit back. The planning process and the inherent weaknesses for which the projects are not working as planned have been shown diagrametrically in Fig.4-5. This diagram reveals the inadequacies in the different stages of planning, implementation and O&M, that are responsible for deterioration of the project performance which ultimately lead them to rehabilitation.

The three projects considered for detail review of planning approach under rehabilitation programme are CEP Polder 64/1A at Bashkhali, Chittagong, CEP Polder 55/1 at Golachipa, Patuakhali and Pagner Haor in Sunamganj district. Findings of different factors considered for planning at Rehabilitation stage



FLOW CHART OF THE PRESENT DAY PLANNING PROCESS

INADEQUACIES IN PRESENT PLANNING PROCESS

FIG. 4-5

with that of original project is shown in Table 4.5.1, 4.5.2 & 4.5.3. The project wise analysis are as follows:

(a) Review of the rehabilitation planning of CEP Polder 64/1A, Bashkhali, Chittagong

The project is currently being rehabilitated. The embankment on the seaside are being retired where eroded and resectioned on the Jalkader Khal side (Fig. 4-3). The sea side is the worst affected embankment by action of waves. At two locations this embankment is being protected by hard protection with C.C. blocks under FDR programme. But during the cyclone of April,1991 the hard protection work was damaged immensely proving that this investment is not effective. But the same hard protection work are being extended and repaired under SRP programme knowing fully well that these cannot save the embankment. The reach that are being retired in one year are almost washed away in the next year and the recurrent expenditure is very high. The work undertaken under SRP programme is the reconstruction of the retired embankment under FFW programme, which does not provide a sustainable solution. A possible long term solution is the afforestation of the sea bank along a strip and realigning the embankment well inside the forest.

In the cyclone of 1991, few thousand people died in this polder by tidal surge. These embankment only gave them false security sence. In the rehabilitation programes, two new road bridges are going to be constructed for quick movement to the upozila headquarter and to high lands towards the east especially during the time of tidal bore. Instead of these road bridges, these money could be spent for Construction of cyclone shelter which could save the life of some people during the time of distress.

In this polder some people produce salt in the winter by allowing water through the flap gates. As the salt water allowed destroy the crop lands this practice have generated conflict among the farmers and salt growers in some places. No solution of this issue was thought of during rehabilitation planning.

Thus during the SRP rehabilitation planning, it was only tried to restore the original project. But the issues of sustainable maintenance of sea dyke, the shelter of the people during tidal bore, enclaving some area for salt bed preparation by marginal dyke and alteration of the sluices for entering saline water inside was not thought of. The system of fall boards in country side of the sluices have been proposed to be replaced as original. But its effectivity was not proved successful in the past then why the same repetation again. Instead, vertical lift gate in the c/s could meet the water retention requirement, but it was not proposed during rehabilitation planning. O&M issues though have been identified correctly but no definite proposal for sustainable O&M was made at this stage of planning. A comparison of the planning aspect considered at rehabilitation stage to that of original planning stage is given in Table 4.5.1.

Table 4.5.1: Comparison of planning aspects of Polder 64/1A

Sl. No.	Factors	Original Project	Rehabilitated Project
1.	Hydrology	Not adequately considered	Considered adquately
2.	River morphology	Not adequately studied	Not adequately studied
3.	Need of flood/salinity control	Considered adequately	Considered adequately
4.	Drainage Improvement	Found in adequate	Considered adequately
5.	Abnormal hydrological event as cyclone, tidal bore, drought etc.	Not considered	Not considered
6.	O&M aspects	Not considered	Considered
7.	Impact on Pisciculture, livestock etc.	Not considered	Not considered
8.	Impact on Boat Traffic	Not considered	Not considered
9.	Impact on Project outsiders	Not considered	Not considered
10.	Environmental issues	Not considered	Problem identified but not made a part of project intervention
11.	Issues of credit and other inputs	Not considered	,,
12.	Agricultural extension and motivation	Not considered	,,
13.	Beneficiary participation in operation and maintenance	Not considered	Not considered

(b) Review of Rehabilitation Planning of CEP Polder 55/1, Golachipa, Patuakhali

The sea dyke of the polder (Fig. 4-2) is the worst affected area where retirement work have been undertaken under FDR & SRP programmes knowing well that it will not give a viable solution. Again the concept of afforestation along the river bank and aligning the embankment behind the forest, which could provide a sustainable solution was not thought of at the rehabilitation planning stage.

The sluices are being fitted with the vertical left gate in the country side. This is an improvement in the planning concept as these sluices would then be able to regulate the water inside the project.

Boalia khal, which is the biggest natural khal have been closed during the Construction of this polder. But the potential of this vast water bodies have not been harnessed. The fish migration route from the peripherial river into the polder have been cut off by closing this khal, which have substantially reduced the open water fish production in the polder. But the potential of culture fisheries in this vast water bodies have not be looked at the rehabilitation planning stage and adverse impact of the project on fisheries have just been overlooked.

This polder is a very potential one for irrigation as the peripherial water remains sweet for major time of the year. A good concept of developing gravity irrigation system by constructing irrigation canals and check structures along with flushing regulators are being constructed as rehabilitation component. This intervention have great potention of extension of gravity irrigation area specially during monsoon and intensify the production of transplanted Hyv Aman. A pilot programme of onfarm development are going to be taken up under SRP and if proved successful will be introduced in similar other polders in the coastal region for supplemental irrigation.

In this polder, though there is sufficient sweet water in Boalia khals and other water bodies, winter irrigation for Boro crops using LLPs have not expanded upto expectation. It is partly due to the intrusion of saline water through the broken flaps in the sluices. After rehabilitation, situation is expected to be more favourable. But the expansion of winter irrigation through LLPs depends on many other factors like credit and other inputs supply which should be properly attended to by concerned agencies.

As the farmers and fishermen are very poor, the traditional village money lenders are sucking their blood from old time but there have not been any change even after completion of this project to any remarkable level. The government's institutional credit support programme also could not make any impact for many reasons and this issue has again not been addressed or any remedy suggested in the SRP planning though it is a agricultural development project. O&M issues though identified correctly but no definite proposal was suggested in rehabilitation planning. A comparison of the planning aspect considered at rehabilitation stage to that of original planning stage is given in Table 4.5.2.

(c) Review of Rehabilitation planning of Pagner Haor Boro Protection Project, Sunamganj

The main aim of this project is to protect the Boro rice till middle of may from the flash flood in the peripherial Nowa and Nowa Boalia river. The submersible embankment of this project were partly constructed under Food for works programme during the last years. (Fig. 4-4)

In the Rehabilitation Programme these embankment are being properly sectioned and the closures on the small khals are being constructed. Two big regulators are being constructed on the outfall of the two khals to ensure post monsoon drainage and controlling the intrusion of flash flood in April and May. More over the internal khals will be reexcavated for improving the drainage of the beels in the project.

The project planning have followed the typical partial flood protection concept in the deeply flooded area of Bangladesh. Unlike other projects vertical steel gates have been provided on country side and river side of the regulators and these are likely to offer better services in flood control and drainage improvement and water retention.

Table 4.5.2: Comparison of planning aspects of Polder 55/1

Sl. No.	Factors	Original Project	Rehabilitated Project
1.	Hydrology	Not adequately considered	Considered adquately
2.	River morphology	Not adequately studied	Not adequately studied
3.	Need of flood/salinity control	Considered adequately	Considered adequately
4.	Drainage Improvement	Found in adequate	Considered adequately
5.	Abnormal hydrological event as cyclone, tidal bore, drought etc.	Not considered	Not considered
6.	O&M aspects	Not considered	Considered but no sustainable programme made
7.	Impact on Pisciculture, livestock etc.	Not considered	Not considered
8.	Impact on Boat Traffic	Not considered	Not considered
9.	Impact on Project outsiders	Not considered	Not considered
10.	Environmental issues	Not considered	Problem identified but not made a part of project intervention
11.	Issues of credit and other inputs	Not considered	,,
12.	Agricultural extension and motivation	Not considered	On farm development work going to be introduced
13.	Beneficiary participation in operation and maintenance	Not considered	Not considered

Like all other projects, the submersible embankment of this project will have to be maintained every year and will be recurrent maintenance problem. The possibility of localized drainage congestion will remain in this project also as the small khals and creeks are being closed and the possibility of public cut after the recesion of the monsoon will remain to continue like in all other similar projects.

Two compartment bunds with 21 gated pipe structures are being constructed under rehabilitation programme. The object is to retain water for irrigation and also the improvement of communication. But not much irrigation coverage should be expected as the retained water is very insignificant to meet irrigation requirement. The gated pipe culverts will only help to evacuate water retained in the higher ridges during drainage period. The performance of these structures will remain a question till it is fully operated. However the compartmental bundh will meet the communication requirement of the farmers.

On re-excavation of the khals it is expected that the beels will be evacuated early than the pre-rehabilitation period. As these Haors are also good habitat of open water fishes, the early drainage are not helpful for fish growth. So like all other partial flood protection project this project will also generate conflict between the farmers and fishermen of the locality.

Like others, this deeply flooded project is a mono cropped area. Local and Hyv Boro are the only major crop grown here and farmers becomes jobless for about four months in the year. As a result they are very poor and the land are owned by big land holder. So the project benefit will also be enjoyed by those land holders. As the farmers are poor, the traditional local money lenders are sucking their blood to starvation from very old days. It was learnt from them during discussion that they have no access to Govt. credit scheme through Krishi Bank or BRDB. And ironically the planners of the rehabilitation project did not consider this vital issue of welfare of the farmers. Only the structural solution grasped their main concern. No proposal for sustainable O&M of the project was made in the feasibility report. A comparison of the planning aspect considered at rehabilitation stage to that of original planning stage is given in Table 4.5.3.

Table 4.5.3: Comparison of planning aspects of Pagner Haor Project

Sl. No.	Factors	Original Project	Rehabilitated Project
1.	Hydrology	Not adequately considered	Considered adquately
2.	River morphology	Not adequately studied	Not adequately studied
3.	Need of flash flood control	Considered adequately	Considered adequately
4.	Drainage Improvement	Found inadequate	Considered adequately
5.	Abnormal hydrological event as cyclone, tidal bore, drought etc.	Not considered	Not considered
6.	O&M aspects	Not considered	Considered but not made part of project intervention
7.	Impact on Pisciculture, livestock etc.	Not considered	Not considered
8.	Impact on Boat Traffic	Not considered	Not considered
9.	Impact on Project outsiders	Not considered	Not considered
10.	Environmental issues	Not considered	Problem identified but not made a part of project intervention
11.	Issues of credit and other inputs	Not considered	,,
12.	Agricultural extension and motivation	Not considered	,,
13.	Beneficiary participation in operation and maintenance	Not considered	Not considered

4.6 DISCUSSION

In the preceding section it has been shown that at the rehabilitation planning stage, the original project were simply restored and in many cases new structures were taken up for solving some objectives that were not achieved earlier.

During the rehabilitation planning not much efforts were given for improving the environmental damage done by project intervention. For example, the open water fisheries in the polder 55/1 have diminished. No scheme for culture fisheries in the Boalia khal have been suggested nor the afforestation of the river side of the sea dyke in this project. The poor road and boat communication of this project also had not been considered during this phase of planning. The proposed intensive gravity irrigation through the flushing sluices and the associated on farm development project is a very potential concept in polder 55/1. But again the agricultural inputs and credit should have to be ensured by the government at a more workable environment to farmers and then only this endeavour will meet success.

Similarly polder 64/1A project, tree plantation along seaside of the embankment and retiring it behind the forest could be a very reasonable alternate solution in consideration of performance and sustainable maintenance of seadyke of this project. But this alternative were not thought of during planning stage. They proposed the rehabilitation of the hard protection works which were proved useless during the disastrous cyclone of April, 1990.

The peoples' participation or their commitment for shouldering the operation and maintenance expenditure of the project were not looked for at this stage of planning also. In the SRP project a pilot programme for cost recovery in the completed irrigation projects as Muhuri, KIP and MIP are undertaken and are expected to be introduced in similar other projects where irrigation is a major component and BWDB is making water available to the farmers. This will ensure the long term sustainability of the project.

However, SRP is introducing improved operation and maintenance programme in some selected projects like Chandpur Irrigation Project, Karnafully Irrigation Project, Muhuri Irrigation Project and in other seven small projects in Nawabganj district. The aim of this intervention is to form EMG (Embankment Maintenance Group) and SMG (Structure Maintenance Group) for maintenance of embankment and structures with the landless local poor and hand over the responsibility of maintenance to these groups under the over all supervision of BWDB. This programme have started from the 1st project year in 1991 and its success is yet to be verified. And if found successful, the programme are likely to be introduced in the projects which are under rehabilitation like CEP polder 64/1A, 55/1, Pagner Haor and similar other projects.

In an agricultural development project a planner's objective of people's welfair should include not only the improvement of agriculture alone but that of pisticulture, poultry, forestry and livestock etc. should be properly attended. These have not been looked at the rehabilitation planning of these projects. A comparison of different factors considered for planning at rehabilitation stage for the three projects are shown in Table 4.6.1.

Table 4.6.1

Projectwise comprison of planning aspect

Sl. No.	Factors	Rahabilitation planning			Remarks
		Polder 55/1	Polder 64/1A	Pagner Haor	
1.	Hydrology	Considered adequately	Considered adequately	Considered adequately	Hydrological analysis done in more details in rehabilitation planning than done in original planning stage
2.	River Morphology	Not adequately studied	Not adequately studied	Not adequately studied	Not analysed at any stage of planning
3.	Need for Flood/Salinity Control	Considered adequately	Considered adequately	Considered adequately	Considered at original and rehabilitation planning stage
4.	Drainage Improvement	Considered adequately	Considered adequately	Considered adequately	Inadequate consideration done at original planning stage
5.	Abnormal hydrological events as cyclone, tidal bore, drought etc.	Not Considered	Not Considered	Not Considered	This was not considered at any stage of planning
6.	O&M aspect	Considered	Considered	Considered	No programme for sustainable O&M are being implemented
7.	Impact on pisciculture & livestock	Not Considered	Not Considered	Not Considered	Not considered at any stage of planning
8.	Impact on boat traffic	Not Considered	Not Considered	Not Considered	Not considered at any stage of planning
9.	Impact on project out siders	Not Considered	Not Considered	Not Considered	Not considered at any stage of planning
10.	Environmental Issues	Not Considered	Not Considered	Not Considered	Not considered at any stage of planning
11.	Issues of credit and other inputs	Not Considered	Not Considered	Not Considered	Not considered at any stage of planning
12.	Agricultural Extension and motivation	Considered	Not Considered	Not Considered	Polit project is being implemented for onfarm development of Polder 55/1
13.	Beneficiary Participation and motivation	Not Considered	Not Considered	Not Considered	Not considered at any stage of planning

CHAPTER-V

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

The aim of this study was to compare the planning aspects considered at rehabilitation stage to that of original project and also investigate how far the planning have considered different aspects which stood in the way of accruing the project benefit.

During Planning at rehabilitation phase many aspects as hydrology, drainage congestion, operation of the structures and their maintenance have been addressed. It has been noticed that the planners mainly tried to restore the original projects by rehabilitating the structures, embankment, canals etc. Drainage problem have also been addressed by adding new structures. But in most cases the planners did not suggest any mitigation measures to the negative impacts of the project. Adverse affects includes reduction of fisheries and livestock, inconvenience to boat communication, rapid siltation of the water bodies, inconvenience to project outsiders etc. The socio-economic aspects like, participation of project beneficiaries in the sustainable O&M, the supply of input & credits to the farmers, participation of the beneficiaries in community forestry or the afforestation along the sides of the dykes did not receive due attention of the rehabilitation planners. Thus though in the planning of the rehabilitation of the projects improvement have been achieved in comparison to original projects, yet many aspect which concerns the farmers and other project beneficiaries have neither been looked seriously nor any remedial measures have been suggested.

The main aim of FCDI projects are the development of agriculture and associated activities as fisheries, forestry, livestock, poultry etc. and ultimately to generate more resources for the increasing population of the country. So the planners of the FCDI projects while proposing to maximize benefit should ensure minimum interference to the existing nature and environment. A guide lines for the project planners are summarised below:

- FCDI - physical infrastructure should have minimum interventions in the natural water courses and flood flows.
- Project intervention should help increase of cropping intensity, severity and diversity.
- Project intervention should ensure human security from flood, draught cyclone, tidal Bore etc. No false security to be given.
- Project should not destroy fisheries, if so happens there should be alternate remedial measures.
- Project should not discard boat communication of the villagers.
- Project should not have detrimental impact on outsiders and overall regional Hydrology by way of raising water level, siltation or erosion etc,
- The timely and efficient drainage of the protected land through the regulators should be adequately ensured.
- The sustainability of the project maintenance and operation with the co-

operation of the beneficiaries should be ensured before project implementation.

- The demand of agricultural and financial inputs and extension services should be a part of the project's planning requirement.
- The impact on cattle farming, Agro and community forestry should be very clearly assessed.
- Preservation of project documents and as built drawings should be made mandatory in planning and implementation offices.
- Study on the impacts on environments should be mandatory.

5.2 RECOMMENDATION FOR FURTHER STUDIES

In course of the present review many aspects of project intervention and impacts came to the author's notice which need further detail investigation and study to know more about them. The major among them are as follows:

- Impact of FCDI interventions and of Agrochamicals on open water fisheries
- Prospect of culture fisheries in completed FCDI projects
- Causes of drainage insufficiency
- Optimisation of opening sizes in drainage sluices with respect to standard (1.5x1.8m) opening usually being followed by BWDB
- Performance of sloping glacis and stilling basin in low head water regulation structure
- Causes of erosion and deep scour in u/s and d/s of regulating structures
- Causes and remedies of embankment cut by the people
- Agricultural credit and inputs - a dilemma for the poor farmers
- Impact of FCDI projects on live stock and draught power
- Use of fixed weir or spillways for water regulation as alternate to regulator with moveable gates.
- Beneficiary participation in Sustainable Operation and Maintenance
- Economic feasibility of HYV rice production - crop price isse and the deprived farmers.

REFERENCES

Bangladesh Bureau of Statistics (BBS,1991)	Bangladesh Statistical year book 1990.
BWDB, 1988a	Fourth Evaluation of EIP Projects, Engineering Study, Bangladesh Engineering & Technological Services Ltd.
BWDB, 1988b	Evaluation Study of Drainage and Flood Control II project, Bangladesh Engineering and Technological Services Ltd.
Bangladesh Unnayan Parishad, (BUP. 1982)	A Socio-Economic Evaluation of Chandpur Irrigation Project.
Dhaka University (DU, 1986)	Evaluation Study of Brahmaputra Right Embankment under DFC-I.
Master Plan Organization (MPO, 1991)	Evaluation of Historical Water Resources Development and Implications for the National Water Plan.
MPO, 1987	Agricultural Production System. Technical Report 14, Master Plan Organization. Ministry of Irrigation, Water Development and Flood Control, Dhaka.
BWDB, 1979a	Feasibility Report of Chalan Beel Project, NEDECO, The Hague.
BWDB, 1979b	Feasibility Report of Satla Bagda Project, NEDECO, The Hague.
International Engineering Company (IECO, 1964)	Flood Control Plan for East Pakistan, Dhaka.
James,L.D. and Lee,R.R,1971	Economics of Water Resources Planning, McGraw - Hill Book Co. USA.
Kuiper,E. 1965	Water Resources Development, Butter Worth and Co. Ltd. London.
United Nations Development Programme (UNDP, 1989)	Bangladesh Agricultural Sector Review, Final Report.
World Bank, 1990	BWDB System Rehabilitation Project, Staff Appraisal Report.
Ahmed Ferdous, 1987	Evaluation of the benefits of some Flood Control measuresin Bangladesh, M.Sc. Thesis, BUET.

FPCO, 1992	FCDI Agricultural Study. FAP 12, FPCO, 1992, Vol. I, II, Services & III, IV, Hunting Technical and Others.
BWDB, 1988c	Feasibility Report of Rehabilitation for Coastal Embankment Project, Polder 55/1, Patuakhali, EPC, Harza & Macdonald.
BWDB, 1988d	Feasibility Report of Rehabilitation for Protection of Boro Corps in Pagner Haor, Sunamganj, EPC, Harza & Macdonald.
BWDB, 1988e	Feasibility Report of Rehabilitation for Coastal Embankment project Polder 64/1A, Chittagong, EPC, Harza & Macdonald.
World Bank, 1990a	Project Performance Audit Report, Drainage and Flood Control Project.
BWDB, 1967	General O&M Manual for Coastal Embankment Project, Leed Shill Delew Engineers
World Bank, 1985	BWDB Operations and Maintenance Study.
UNDP, 1989a	Bangladesh Flood Policy Study, Final Report.
Flood Plan Co-ordination Organization (FPCO, 1991)	Guidelines for Project Assessment FPCO.
World Bank, 1987	Second Small Scale Flood Control, Drainage and Irrigation Project. Staff Appraisal Report.
World Bank, 1989	Bangladesh Action Plan for Flood Control.

CHECK LIST FOR DATA COLLECTION THROUGH FIELD VISITS

A POINTS FOR DISCUSSION WITH BWDB OFFICIALS

1 General description of the schemes:

- age of the scheme
- general condition of the infrastructure
- area irrigated/protected and cropping intensity (actually and according to design)
- amount of water supplied, water distribution
- areas of interventions (O&M, etc.)
- investment costs of interventions
- recurring costs
- staffing of BWDB

2 Expected period of benefits

3 Crop damages/yields affected (over the last 5 years)

4 Number of villages, number of households, total population, range of size of villages

5 Villages completely flood-free/flooded (indicate on map)

6 Why did they not maintain structures, etc. properly ?

7 Will the beneficiaries pay O&M costs or contribute with their labour ?

8 How could the full benefits of the scheme be realized ?

9 What special recommendations could they make for smooth O&M ?

10 Are maps available of the scheme, also indicating villages ?

11 Could they indicate different types of villages according to level of benefits, i.e. well endowed, normally endowed and less endowed in terms of irrigation facilities, access to markets and to government services ?

B POINTS FOR GROUP DISCUSSIONS WITH VILLAGERS

1 Benefits and distribution of benefits.

1.1 Awareness about the projects and their areas of benefits.

1.2 Principal means for accrual of benefits.

1.3 Who will be the most benefitted ? Farmers vs non-farmers.

1.4 Proportion of different occupational groups benefitted ?

1.5 Experiences of level of benefits from the project; increasing or decreasing over time ? Has the area actually irrigated/ protected decreased ? To what extent ?

1.6 Is the general standard of living increasing or decreasing in their area, e.g. health, education ?

1.7 Good and bad time for employment and consumption: in which season of the year do the people suffer most ?

2 Water Management and Agriculture.

2.1 How is on-farm water management organized/arranged ?

2.2 Which type of cultivated land (high/low) will be benefitted from the project ? Would land levelling or terracing be necessary or beneficial ?

2.3 Principal changes in cropping pattern over the last five years.

2.4 Agricultural losses due to malfunctioning of irrigation infrastructure and to excessive floods.

3 Farmer's organizations and government support

3.1 What kind of cooperatives, informal associations and other farmers' groups do exist and what is their function ? Do the beneficiaries participate in their management ?

3.2 What kind of government support services for OFD do exist and are they effective ?

3.3 Who benefits most of them and who will be adversely affected ? What remedial measures can be suggested ?

4 Operation and Maintenance and on-farm development.

4.1 Are the beneficiaries prepared to participate in the O&M and the OFD programmes ?

4.2 Are women prepared to work in maintenance works ? Or to form Earthwork Maintenance Groups and Structure Maintenance Groups which would get regular contracts from the BWDB ?

4.3 Who participates in water management committees, like sluice committees ?

5 General outlook

5.1 What are the most important problems in the project and what do the government agencies do to remedy these ?

5.2 Do they consider any alternative measures to solve these problems ?

6 Specific points for women

6.1 What effect would an increase in production have on their workload ?

6.2 Would the intensification of work be detrimental to child care ?

6.3 Would the division of labour between men and women have to change ?